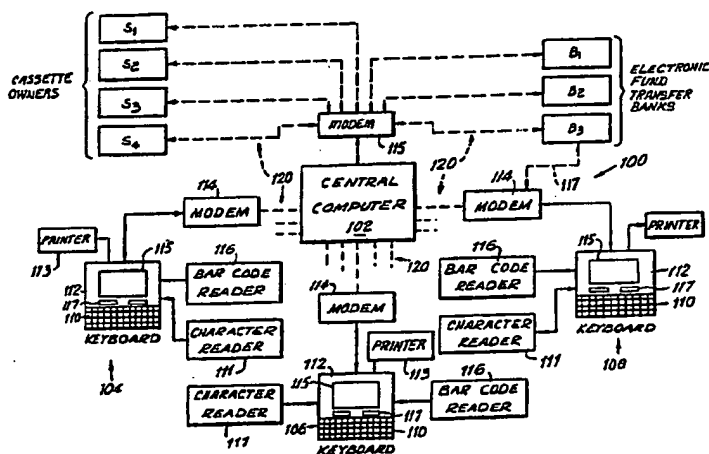




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(54) Title: VIDEO CASSETTE RENTAL SYSTEM AND METHOD AND RECORD PLAYBACK COUNTER THEREFOR



(57) Abstract

A computerized video record rental system and method in which a video record unit such as a tape cassette (250) is provided with an integral counting device (5) for counting the number of times the record is played. Upon rental and return of the record, the counts are recorded in computer memory, together with an identification of the record unit, and the computer (104) computes the rental fee due based on the net play count for the record unit. A central computer (102) is provided at a location remote from the rental sites and is connected to the computers (104, 106, 108) at the rental sites. The preferred counting device (24) in the video cassette (250) uses caliper arms (17, 19) to detect the position of one of the tape rolls in the cassette at two points on opposite sides of the roll and drives a counter (23) in proportion to changes in the distance between the points. An alternative is a hybrid system using a mechanical tape motion sensor (38) and an integral electronic counter and memory (280), with an LED read-out (228) in a form which is readable by a bar-code scanner (116).

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Video Cassette Rental System and
Method and Record Playback Counter Therefor

1

TECHNICAL FIELD

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This application is a continuation-in-part of pending United States patent applications Serial No. 86/009340, filed April 21, 1986; Serial No. 117,813, filed November 5, 1987, and Serial No. 160,022, filed February 24, 1988.

10

This invention relates to video record rental systems and methods, and to devices for ascertaining and indicating the number of times a recording has been played or used.

15

Rental of recorded matter is developing rapidly; the estimated retail turnover of video cassette rental already compares favorably with the gross proceeds from book publishing and record manufacturing. Commercial record rental is not widespread but this state of affairs may well alter in the light of increasing production of the so-called "compact discs". Like video cassettes, these are relatively expensive and rental may increasingly become an attractive alternative to outright purchase.

20

If an analogy can be drawn between a "blockbuster" film costing many millions of dollars to make and an author's manuscript, then a rented video cassette can be equated with such an article as a hardback edition of a book in a lending library or in a book exchange establishment.

25

The studios and major distributors initially completely failed to see that, in allowing the sale or rental of these copies of the original film - purely as a sideline, they thought - they were shifting the very foundation of their enterprise. Unfortunately, this sideline is becoming the mainline, and the more quickly the screen production business recognizes the fact and restructures itself on a new foundation, the less damage it will suffer.

30

The studios and major distributors, then, clearly fell into the trap of perceiving video as a sideline or ancillary market. That mistake allowed them to acquiesce in the establishment of a system of video distribution that effectively cuts them off from control of the use of their

35

1 own copyright material, denies them any direct participation
in the exploitation of that copyright, permits blatant
piracy of that copyright and seriously inhibits full
exploitation of that copyright on behalf of the copyright
5 owner.

It is a well-recognized fundamental rule of
economic viability that it must be the end user who pays,
but in the video cassette business the great problem is how
is the end user to be made to pay? At present the "video
10 revolution" is in what may aptly be termed its lending
library phase, and an essential problem at the moment is
that it is not ascertainable whether, or how often, a video
tape has been played. It was basically this fact that
aborted initial attempts to charge "per rental". There was
15 no way of monitoring cassettes to ascertain whether a video
tape had been run through once or a hundred times.

Screen production/distribution businesses normally
sell tapes to video rental outlets for the highest price
they are able to get. This is not in the interest of the
20 sellers because the price must be kept low - uneconomically
so - in order to discourage the all-too-prevalent pirate
organizations and to keep down to a reasonable level the
amount of capital required to stock a video rental business.
On the other hand, this price is still relatively high from
25 the point of view of the video shop owner and so discourages
him from distributing as many copies of any particular tape
as he would like to. Thus, in the long term, nobody
benefits.

BACKGROUND ART

30 It is clearly desirable, then, that video
cassettes should be provided with some kind of play-counting
device. One proposal was the so-called "R-Cassette"
developed in the U.S.A. in 1981. This enables a video
cassette intended for rental to lock automatically after one
35 viewing. The cassette can only be rewound by using a
special device, supplied only to dealers, which is linked up
to a central computer that records each "use", thus enabling

1 an exact calculation to be made of the number of times the
video has been hired. This system would also enable
payments to be made to copyright owners, calculated on a per
rental basis. Among the factors that make this system
5 unacceptable are:

1. It frustrates those renters who wish to view
all or part of a program more than once.

2. It loads onto the dealer the time wasting task
of rewinding every tape after rental.

10 3. It does not uniquely identify cassettes and so
permits the continued depredations of pirates.

4. It requires dealers to invest in equipment
that is otherwise irrelevant to the operation of his
business.

15 The other system is known as the "Screen Key Card"
system and operates by recording the material to be rented
on cassette in a scrambled form. Customers are issued with
a card containing a de-scrambling code which must be used in
order to gain access to the video tape. This card also
20 contains coded details of the subscriber's name, address,
etc, thus enabling identification, invoicing and payment for
each rental use. Each time the customer rents, the relevant
de-scrambling code is programmed into the card and each time
the de-scrambler is activated an electronic mark is made on
25 the de-scrambled material. This system, however, requires
the acquisition of special and complex hardware by every
renter and appears to offer no auditing capability to the
distributor.

Other proposals for counting and displaying the
30 number of plays of a cassette have been proposed, but none
has proven successful.

United States Patent No. 3,995,319 discloses an
audio tape cassette having a mechanical counter actuated by
a geared arm in one corner of the cassette, the counter arm
35 having a stop which stops the arm at an integral count so
that the arm stands clear of the tape wound on the spool.
This system has problems rendering it impractical. In

1 particular the angle of the sensing arm in relation to the
tape is likely to cause jamming, and uneven tension on the
tape results from the fact that the arm, at times, stands
clear of the tape and, at times, rubs against the tape. The
5 space in the corner of a cassette is too restricted for
location of an inexpensive and reliable counter mechanism.
Furthermore, the movement of the tape reels inside the
cassette when it is shaken would make such a device subject
to false indexing.

10 United States Patent No. 4,466,584 discloses video
cassette having an escapement driven counter, actuated by a
rocking member having two feeler arms in the free space
between the spools, one riding on the tape wound on each
spool. While this arrangement avoids the problem of the
15 restricted space in the corner of a video cassette which
prevents the use of the device disclosed in United States
Patent No. 3,995,319 on video tape cassettes, the escapement
drive is complicated, and reliance on the wedging action
between the tooth of the rocking member as it is radially
20 driven into the toothed wheel to provide the wedging force
to move the toothed wheel is unreliable. Further-more,
because the radius of the tape spools does not change
linearly as the tape is played, at times, enough free space
may be left between the arms and the spools to permit
25 shaking of the cassette alone to falsely register a count
(or to subtract a count). Also, the problem of uneven
tension on the tape is still present since the arms are not
continuously urged against the tape. Still further, the
counting mechanism disclosed in United States Patent No.
30 4,466,584 interferes with the spool brake, typically present
in video tapes, because all space is taken up by the rocking
member and escapement mechanism.

OBJECTS OF THE INVENTION

It is an object of the invention to provide a
35 computerized video record rental system and method in which
the foregoing disadvantage of prior proposed systems and
methods are eliminated or greatly alleviated, and to provide

1 an integral counting device in the record container which
overcomes the similarity debilitating defects of prior
counting devices.

More particularly, it is an object of the
5 invention to provide a rental system and method in which
video records, preferably in the form of video cassettes,
can be consigned by the owners of retail outlets who then
rent the cassettes to the public, with the confidence that
the number of times each cassette is played will be recorded
10 accurately, and that the owner will receive a share of the
rental revenues with reasonable certainty and promptness,
and with a minimum of extra labor and equipment costs. It
is another object of the invention to allow the owner of
artistic properties (e.g., motion pictures) recorded on the
15 records to share in the revenues generated by the rentals in
proportion to the popularity of the properties.

It also is an object of the invention to
facilitate the distribution of such records in a manner such
as to maximize the rental revenues for both the retailers
20 and the owners by placing a sufficiently large inventory of
the records in the retail outlets at the time when the
property is the most popular, without requiring an
inordinately large capital outlay by either the retailer or
the owner.

25 It is a further object of the invention to provide
such a system and method in which the rental revenues are
collected and paid to the owners relatively promptly and
with a minimum of human labor, and with a relatively modest
outlay of equipment for use in the procedure.

30 A further object of the invention is to provide a
device for accurately and reliably counting and recording
the number of times the record has been played by the rental
customer. It also is an object to provide such a device
which does not require any modifications of the record
35 player owned by the rental customer; a device which will
operate with any known player and does not interfere with
the operation of the player or require any extra effort on

1 the part of the rental customer to use. It is a further
object to provide such a device which over-
comes or greatly alleviates the shortcomings of prior
devices of the same type, and is of relatively simple and
5 economical construction.

In particular, it is an object to provide such a
device in video tape cassettes which is highly resistant to
or immune to counting falsely in response to normally
adverse conditions occurring during transportation and
10 handling of the video cassette, both within and outside of
the user's tape player.

SUMMARY OF THE INVENTION

The foregoing objects are met, in accordance with
the present invention, by the provision of a computerized
15 video record rental system and method in which a video
record unit such as a tape cassette is provided with an
integral counting device for counting the number of times
the record is played. Upon rental of the record, the count
is recorded in computer memory, together with an
20 identification of the record unit. Upon returns of the unit
to the rental outlet, the new count is entered in the
computer memory, together with the record unit
identification, and the computer computes the rental fee due
based on the net play count for the record unit; that is, on
25 the difference between the count upon rental and the count
upon return.

Preferably, the computer performing the foregoing
tasks is a small computer such as a "personal computer"
located at the rental site. The equipment located at that
30 site preferably includes a printer which prints customer
receipts bearing the identification and count information at
the times of rental and return of the record unit. Input of
the identification code and count information preferably is
by way of scanners or "wands" which read the information
35 electrically. However, input by use of a keyboard also is
possible.

1 It is also preferable that a central computer is
provided at a location remote from the rental sites. The
rental information is transmitted from the rental sites to
the central computer periodically by way of modems and
5 telephone lines, or by way of other data communication
means. The central computer is similarly linked to
computers located at the record owners' place of business.

 It also is preferred that an electronic funds
transfer network be provided to electronically transfer
10 funds from accounts maintained by the retailers to the
owners by way of the central computer. The amounts
transferred from the retailers are equal to the rental
receipts less the portion representing the retailers'
shares. The amounts transferred by the central computer to
15 the owners are equal to those received from the retailers
less any share retained by the operator of the rental
system.

 The central computer provides reports to both the
retailers and the owners. The reports to the retailers
20 include accounts of the retailer's rentals, fees due, etc.
The reports to the owners include total rentals of each
specific artistic property, funds transferred, inventories,
returns, etc.

 The counting device of the present invention
25 preferably is a mechanically activated device which senses
the growth or reduction in size of a roll of video tape in a
cassette. It senses the position of the outer surface of
the roll at two opposite sides of the roll, and drives a
counter in proportion to the changes in the distance between
30 the two positions.

 Preferably, those positions are sensed by
followers which contact the roll and follow its movements.
The followers advantageously take the form of caliper arms
with a rotary counter mounted on one arm and drivably
35 coupled to the other arm, with both arms being pivotably
secured to the cassette housing at a single pivot point.
Thus, the arms are free to swing about the pivot point to

1 follow the movements of the loose tape roll as it moves
laterally in the cassette during handling of the cassette
outside of the record player. In addition, the caliper arms
contact the tape roll at opposed points along the greatest
5 dimension of the roll. These features virtually immunize
the counter mechanism from making false counts due to the
lateral shifting of the roll in the cassette.

Counting may be achieved mechanically, electro-
mechanically, electronically etc., and in this latter regard
10 the invention may consist in a video device including a
capacitive sensor and a logic chip adapted to count
crenellations on a tape reel periphery to thereby sense
movement in a particular frequency band covering a range of
speeds consistent with the play mode; a second sensor for
15 energizing of the circuit; a timer chip pre-set to program
duration of play and triggered by the logic chip, the timer
chip being adapted to time substantially total play fre-
quency duration to produce a threshold signal via the logic
chip; total number of tape plays being recorded and/or
20 displayed for a set rental period and progressive total
number of tape plays being stored for subsequent information
retrieval.

Preferably, the cassette identification
information is marked on the cassette housing in
25 machine-readable coded form, such as a bar code which can be
read by a conventional bar-code reading wand at the retail
site. It is preferred that the count also be
machine-readable.

Another advantageous counting device of the
30 present invention combines a mechanical counting mechanism
with an integral electronic storage and read-out device.
The mechanical count is converted to digital form and stored
in a battery-energized memory element in the cassette
housing. The stored count is converted to an
35 electronically-detectable form and displayed or presented at
the outside of the housing so as to be easily
machine-readable. For example, the count can be displayed

1 by means of a light-emitting diode array which can be read
by a photo-detection type scanner or "wand" at the rental
site, and then sent to the computer memory.

Even more advantageously, the invention provides
5 an all-electronic counting and read-out device. The
read-out device, like the one described immediately above,
provides an electrically alterable bar-coding device. The
counting and read-out means are built into the structure of
one of the tape reels in a cassette, thus providing a unique
10 tape reel which itself indicates the relative tape position,
count of the program plays, and other information relating
to the cassette and program on the tape, etc.

The information to be read out is encoded and used
to create coded optical signals which are read out by an
15 appropriate device. Preferably, the optical signals are
flashes of light produced by a lamp energized by a timed
sequence of electrical pulses. A bar-code reader senses the
flashes. The sequence of pulses simulates the pattern of
signals the reader would read if it were scanning a printed
20 bar-code.

A battery is housed in the reel to supply power.
The lamp is energized only when a pressure switch is pushed,
preferably by a bar-code-reading wand, so as to minimize
power drain and maximize battery life.

25 The counting means comprises one or more flat
lamps and photocell detectors built into one flange of the
tape reel and operated intermittently to detect the growth
or shrinkage of the tape roll on the reel by an amount
indicating that a full play of the program on the tape has
30 occurred.

The invention meets the objectives set forth above
and provides a system and method well suited to make it
practical for movie and other artistic property owners to
rent their properties and derive maximum revenue from them,
35 while reducing capital outlays for the rental stores and
materially increasing the availability of the artistic
properties to the public.

1 The foregoing and other objects and advantages of
the invention will be set forth in or apparent from the
following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

5 In order that the reader may gain a better
understanding of the present invention, certain preferred
embodiments thereof will be hereinafter described by way of
example only, and with reference to the accompanying
drawings in which:

10 Figure 1 is a schematic block diagram of a
preferred embodiment of the computerized video record rental
and accounting system of the present invention,

 Figures 2 and 8 are rear end elevation and top
plan views, respectively, of one of a preferred video
15 cassette constructed in accordance with the invention
adapted for use in the system depicted in Figure 1, having a
built-in mechanical counting device for recording the number
of plays of the cassette and showing the numerals of the
counting device through a viewing window; with Figure 8
20 showing the cassette with the top wall of the casing
removed;

 Figure 3 is a top plan view of another video
cassette constructed in accordance with the invention, shown
with the top cover removed;

25 Figure 4 is a schematic plan view of another video
cassette constructed in accordance with the invention, with
the cassette case removed;

 Figure 5 is a perspective view, partially
schematic, of a portion of another cassette embodying some
30 of the basic principles of the embodiment of Figures 2 and
8;

 Figure 6 is a perspective view, partially
schematic, of a portion of another cassette constructed in
accordance with the invention;

35 Figure 7 is an exploded view of another embodiment
of the counting means of a video cassette constructed in
accordance with the invention;

1 Figure 9 is an enlarged plan view of a mechanical counting device very nearly the same as that of the video cassette depicted in Figures 2 and 8;

5 Figure 10 is an enlarged perspective view of the numeral wheel and actuating arm portion of the mechanical counting device depicted in Figures 8 and 9;

10 Figure 11 is an enlarged elevation view, taken in the direction "A", of the numeral wheel portion of the mechanical counting device depicted in Figure 8;

15 Figure 12 is an enlarged view, taken in a direction opposite to the direction "A" of the numeral wheel portion of the mechanical counting device depicted in Figures 8 and 11;

20 Figure 13 is an enlarged top plan view of the tape spool brake depicted in Figure 8;

 Figure 14 is a cross sectional view, taken along the line 14-14 of Figure 13, of the tape spool brake depicted in Figures 8 and 13, with a portion of the cassette casing;

25 Figure 15 is a cross sectional view, taken along the line 15-15 of Figure 13, of the tape spool brake depicted in Figures 8 and 13, with a portion of the cassette casing;

 Figure 16 is a schematic circuit diagram of another embodiment of the play-counting cassette and system of the invention.

30 Figure 17 is a cross-sectional, partially broken-away and partially schematic view of a tape cassette and electronic counting/readout device of the invention;

 Figure 18 is a perspective view of a portion of the device of Figure 17;

 Figure 19 shows a portion of the view of Figure 17 during read-out;

35 Figure 20 is a cross-sectional view, like Figure 17, of a portion of the preferred form of the device of Figures 17-21;

 Figure 21 is a schematic circuit diagram of the operating circuit of the preferred device of Figures 17-21;

1 Figures 22 and 23 are schematic diagrams
illustrating the basic features of a typical bar-code
reading wand utilized with the invention; and

 Figure 24 is a schematic plan view of tape
5 detectors used in the device of Figures 17-21.

DETAILED DESCRIPTION

 Figure 1 of the drawings shows a computer system
100 for video cassette rental and accounting control. The
system includes a central computer 102 and a plurality of
10 remote "point-of-sale" terminals 104, 106 and 108, which are
merely three examples of the much larger number of terminals
typically comprising the system.

 Each terminal 104, 106, 108, etc., includes a
keyboard 110 and a microcomputer 112 such as any of a number
15 of commercially available personal computers ("PC's"). Each
terminal also includes a printer 113, a bar code reading
device 116, and a modem 114. The terminal is located at a
retail rental store, for example, and is coupled to the
central computer 102 through the modems 114 and telephone
20 lines 120.

 Each of the computers 112 in the retail store
terminals 104, 106, etc., preferably has a CRT display
screen 115 and hard disk and soft disk drives for program
and other storage tasks, as well as RAM and other electronic
25 memory, as is customary with most conventional PC's.

 Stored in each computer 112 is an operating
program and an application program. The application program
consists of a conventional module such as the "Master Video"
module sold by Bonifide Management Systems, Inc. of Reseda,
30 California, which is used in many video cassette sales and
rental stores for various accounting functions specific to
such businesses, together with modifications necessary to
perform the new tasks to be set forth below. Since those
modifications are well within the skill of the art to make,
35 the specific steps used in the modifications will not be
described in detail herein.

1 As it is shown in Figure 2, each tape cassette 250
includes a play counter 252 which provides a count of the
total number of plays of the cassette, which is preferably
visible through a window 253 at the back edge 255 of the
5 cassette.

Also on the back edge of the cassette is a bar
code 254 which uniquely identifies the cassette, i.e. the
copyright owner, title, copy number etc. Typically, a
12-digit code is used.

10 In accordance with the method of the invention,
the rental of video cassettes is accomplished as follows.
Preferably, the video cassettes are owned by a business
entity which records the cassettes or is a cassette
distributor. That entity merely consigns or loans the
15 cassettes to the retailers. For example, the business
entity is a motion picture studio or distributor which owns
the artistic property recorded on the cassettes.

When a cassette is rented at a retail rental
store, the rental clerk reads the bar code 254 on the
20 cassette into the central computer 102 through the modem 114
by means of the bar code reader 116. Preferably, however,
the bar code is read into the rental computer 112 in the
retail store. The reader 116 is of conventional
construction and is one of the types typically used in
25 point-of-sale terminal systems. If no bar code reader is
available, or if the bar code reader malfunctions, the
identifying information can be entered by means of the
keyboard 110. For this purpose, the information represented
by the bar code also is printed on the cassette in
30 alphanumeric characters readable by humans.

The clerk also inputs to the computer 102 or 112
the play count from the counter 252 by means of the keyboard
110. Alternatively, the count may be read by a character
reader 111, or by the bar code reader itself, if the system
35 shown in Figure 16 is used.

Preferably, each customer is given an
identification number. If the customer is a member of a

1 "rental club", he or she already has such a number. If not,
a number is assigned, principally in order to establish a
credit and trustworthiness history for customers, in order
to minimize cassette and rental revenue losses.

5 A printed record of the transaction, including its
date, the initial payment received from the customer, the
rental rate per play, late charge rate, and the cassette
identification and play count, is prepared on the printer
113 of the terminal and given to the rental customer. This
10 data is stored in the memory of the rental computer 112.

When the cassette is returned, the clerk again
reads the cassette identification code 254 into the computer
102 or 112, and inputs the new play count, together with the
amount of any rental or late fees or other fees received
15 from the customer at that time.

In the embodiment in which the central computer
stores the data, the computer 102 uses the bar code to
uniquely identify each cassette, and stores the beginning
and ending play counts, computes the net play count, the
20 rental fee and the difference between the two counts, and
computes the share of the fee to be received by the owner of
the cassette. At the end of each pre-set business time
period, e.g. each week, the computer 102 prepares an invoice
and sends it to the retailer through the telephone lines and
25 modems, to be printed out on the printer of each terminal.

Thus, the system 100 provides for the accounting
and reporting of every rental and invoicing for rental fees
without separate telephone calls, messengers or mailings,
thus making the rental system cost-effective.

30 The system 100 further provides for the collation
of returns relating to each title from multiple outlets and
for the transmission of those returns to the copyright
owner.

In the preferred embodiment of the system 100, in
35 which the rental computer 112 at each terminal 104, 106,
108, etc., stores the data for the individual rental
transactions, the computer 112 is programmed, using the

1 above-mentioned "Master Video" software module, with
modifications, so as to operate as described above on rental
of a cassette, and as described below on return of the
cassette.

5 When the customer returns the cassette, the rental
clerk inputs to the computer 112 the cassette identification
data, either by way of the bar code reader 116, or by use of
the keyboard 110, and retrieves from memory the information
previously stored for the rental transaction. Preferably,
10 this information is displayed on the video display screen
155 of the computer. The rental clerk also inputs the new
count on the cassette counter, either by use of the keyboard
110, or by use of the character reader 111.

 The computer 112 stores for the cassette the
15 rental rate per play, the charge rate for late returns by
the customer, and any other applicable charge rates. The
computer subtracts the beginning cassette count from the
return count, thus computing the net play count, and
multiplies this times the applicable rate to determine the
20 total rental fee.

 Normally, the customer pays a certain minimum
rental fee upon initially renting the tape. For example,
the customer pays at least for a one day rental and one play
of the tape. Thus, if the tape has been played more than
25 once upon return, the computer notes this and subtract the
initial payment made by the customer from the total fee due
and computes a balance to be received from the customer at
that time. When the customer pays the additional money,
this is entered in the computer by the clerk, and the
30 computer updates the total received in the transaction and
indicates its completion.

 If desired, the modem 114 can be of the type which
is continuously enabled, and it immediately transmits to the
central computer the results of the transaction. However,
35 in most stores it is preferable that the modem 114 be of the
"dial-up" type which is connected to the telephone line only

1 when a number or sequence of numbers is dialed on a
telephone dial.

In any event, periodically, such as at the end of
each day, or week, the rental retailer transmits the total
5 rental information stored in the computer 112 during the
period in question.

The central computer 102 is programmed to receive
and store the data from each rental computer 115. Then it
periodically sorts the rental information received from many
10 retail rental outlets and prepares various reports.
Basically, the reports will summarize the number of rentals
and the number of plays of each artistic property rented by
each retail outlet, together with rental receipts for each
property, as well as returns of cassettes to the owners,
15 etc.

The central computer 102 also will sort the data
and prepare total rentals and plays and receipts for the
period from all rental outlets included within the system.
Then the central computer 102 periodically transmits the
20 reports through a modem 115 to terminals S1, S2, S3, S4,
etc., located on the business premises of the cassette
owners. Preferably, each terminal at the cassette owners'
premises also includes a computer for storing the
information received and printing out the reports
25 transmitted.

Payments preferably are made to the owners of the
cassettes and the operator of the system 100 as follows;
each rental outlet maintains funds in an account at one of
several banks B1, B2, B3, which has electronic funds
30 transfer capabilities.

Whenever the central computer 102 receives from
one of the rental computers 112 a periodic report of
revenues, the computer 102 prepares and sends to the
retailer an audit report confirming the information
35 transmitted, together with any other financial information
desired, and requesting confirmation of the correctness of
the audit report. The audit report will include a

1 percentage of the rental receipts which must be paid to the
owners of the cassettes and the operators of the system 100.
For example, if the retail outlet reported \$1000 in rental
revenues for a given period, and the retailer's share of
5 those revenues is 20%, the central computer would indicate
that the remainder, \$800 was to be transmitted by the
retailer.

Of course, the programming of the central computer
102 enables the system operator to poll any rental computers
10 in which rental reports are delinquent, or for other
purposes.

When the audit report is approved by the retailer,
a signal is sent to one of the electronic fund transfer
banks, B1, B2, B3, etc., in which the retailer has deposited
15 adequate funds , or has an adequate line of credit, and the
funds are electronically transferred from the bank through
the modem 115 to the central computer 102. The central
computer then computes the share to be retained for the
operator of the system 100, deducts that, and electronically
20 transmits through the modem 115 to the cassette owners their
share of the rental receipts.

If desired, a data link 117 can be provided
directly between the retailer's terminal and his electronic
fund transfer bank so that he can communicate his approval
25 or disapproval of the request for funds from the central
computer, or so that he can enable payment pursuant to the
retailer's line of credit with the bank.

The electronic fund transfer aspect of the system
and method of the present invention is highly advantageous
30 in that it avoids the delay caused by writing checks, it
avoids the labor of such tasks, and avoids other labor and
handling costs. Of course, payment can be made by mail or
other conventional means, if preferred.

The rental system and method have further
35 advantages in that, since the retailer need not make the
significant investment required in purchasing large numbers
of cassettes, he can stock larger numbers of the more

1 popular cassettes and minimize the number of times he runs
out of stock in the cassettes, thereby increasing the number
of rentals of the program recorded on the cassette. This
brings greater revenues to the producers of the most popular
5 programs than from prior arrangements, in which they merely
sold the cassettes to retailers who then kept all of the
rental income.

The system 100 also makes it economically viable
for the retailer to stock a wide variety of special interest
10 programs that would not normally be kept in stock and return
to the owners of those programs revenue that would otherwise
not have been earned at all.

The rental system and method brings these benefits
to the program owner without inordinately increasing the
15 cassette production costs because the incremental costs of
producing the necessary extra cassettes are relatively low.

In total, the system and method of the invention
benefit all parties; the producer of the cassette, the
retailer and the public, which enjoys the greater
20 availability of its favorite programs.

REFINEMENTS

Some video store software modules such as the
"Master Video" module used in the preferred embodiment of
the present invention, make the printing of receipts to
25 customers optional. For the purposes of the present
invention, the software is modified so as to flag each
cassette rental transaction, and mandate the preparation of
a printed receipt each time a customer transaction includes
such a rental. It is considered to be a substantial
30 advantage to inevitably offer the customer a receipt at the
time of a rental transaction so that he or she will have a
printed record of the rental rates, etc., and will not
become disgruntled upon being billed for per play charges
and late charges when the cassette is returned.

35 Preferably, a "prompt" is added to the software
which causes an inquiry to be displayed on the computer
screen 115 seeking the count number from the rental

1 cassette. The software also is modified to enable the
operator to override the computer requirement for a count
number. This is to allow for the correction of errors, such
as where the starting count was misread by the rental clerk,
5 or where the customer contends that the count must be
inaccurate and the retailer decides to accept the customers
contention. If the prompt is overridden, the clerk cannot
proceed with the transaction until the count number is
entered.

10 Whenever the override function is enabled, an
exception report is generated and ultimately must be
reconciled.

For each artistic property (program), the basic
Master Video software is modified to add the following
15 fields;

- Revenue per play;
- Revenue per day (rental charges for each day,
regardless of the number of plays);
- Late charges per day;
- 20 -Share of per day charges owed to system operator;
- Gross owed to system operator for late charges;
- Total income for all plays;
- Total income for all daily rentals;
- Total income from late charges;
- 25 -System operator charges from per play charges;
- System operator income from daily rate charges;
- System operator income from late charges;
- The last reading on the counter for that
cassette;
- 30 -Location code and indication of format used at
that location (VHS or BETA);
- Quantity of that title on reserve at the retail
location.

35 The "Master Video" module provides a customer
report for each customer showing at least the last ten
rentals by the customer where abnormal activity occurred;

1 e.g., late returns, unpaid counts, etc. This report should
enable the store to restrict rentals or to take the
appropriate steps to insure better customer collections.

Whenever a rental cassette is returned with more
5 than the basic one day/one play charge due (which has
already been paid for by the customer), the operator
automatically will be presented with a customer screen on
the display 115 which indicates to the customer and the
clerk that additional charges must be paid by the customer.
10 If the cassette has been returned by way of a night deposit
box, or by means other than in person, a notice of the extra
charge is stored in the customer's file, which will be
retrieved from memory and presented, either when the
customer next visits the store, or when the computer files
15 are reviewed for the purpose of preparing bills to be mailed
to the customers.

The software modification enables the rental clerk
to override the requirement for the additional charges, such
as where the retail establishment decides to forego such
20 charges due to the fact that the customer is a good
customer, or has a justifiable complaint, etc. Of course,
an exception report is prepared in response to the override.

The usual video store software module includes
instructions for printing receipts for any returns involving
25 late charges. The software is modified to include per play
charges on such a receipt.

Rental rates for long term periods also can be
used in the system. For example, weekly rates can be stored
and retrieved.

30 Upon request, the rental computer 112 prepares an
in-house audit report in order to enable the retail outlet
operator to compute the amount that he must pay to the
system operator. The report figures should match those
transmitted from the central computer 102 to the computer
35 112 and which was described above.

It should be noted that both the cassette owner
and the system operator share in the extra revenue generated

1 by the customer either retaining the cassette for more than
one day, or for extra plays above the one play initially
charged for upon rental of the cassette. Thus, the cassette
owners share in these additional charges as well as in the
5 basic rental fees.

It is preferred that there be two different
identification codes for each cassette; one being the unique
12 digit number described above, and the other being a
different code assigned to that particular cassette by the
10 store owner to facilitate storing and retrieving the
cassette.

In accordance with another advantageous aspect of
the present invention, although cassettes usually are sent
to each particular retail outlet directly from the cassette
owner, it also is possible for a rental outlet to receive
15 cassettes from another rental outlet. Transfer from one
outlet to another can be accomplished in order to transfer
overstock from one rental site to correct an under-stocking
problem at another site.

20 Whenever the owner sends cassettes to any rental
outlet, his computer sends to the central computer 102
information indicating the number of each title sent, the
cassette identification numbers and similar data. The
owners computer will print a packing slip to be shipped with
25 the shipment to the retail outlet.

The system software at the retailer's rental
computer enables him to enter data regarding stock received
and to print out a report that can be matched against the
packing slip.

30 When cassettes are transferred from one store to
another, a similar packing slip is prepared by the sending
store, and information is transmitted to the central
computer 102 just as if the goods were being shipped from
the owner to the receiving store. Thereafter, the receiving
35 store can prepare a received stock report and compare it
against the packing slip.

1 Each rental outlet is required to return the
cassettes it receives to the cassette owner when the rental
life of the cassette is over. For this purpose, the rental
computer 112 is used to prepare a return report which is
5 transmitted to the central computer 102 and the cassette
owner, and the retail rental outlet ships the cassettes back
to the owner.

 The cassette owner then can reuse each cassette
until it is worn out. He can record a new program on the
10 video tape in the cassette, and he can reset the mechanical
counter in the cassette to zero, if he desires.

 The central computer 102 is programmed to keep
track of the total rentals of each title or artistic
property by each store. When it detects the fact that a
15 particular store has reported rentals which are well below
expected norms, then an auditor will be sent to the store to
determine whether the store is accurately recording all
rentals. Since each cassette has an internal mechanical
counter which cannot be disabled without opening the
20 cassette, and because each cassette preferably is made
relatively tamper-proof to make it difficult to disable or
interfere with the normal operation of the counter, the
counters provide reliable means for checking on the
reporting accuracy of various retail outlets. As noted
25 above, various exception reports are provided automatically
by the software. Another exception report is provided
whenever there is an abnormal jump in the recorded count.
In most cases, such jumps will merely be the result of a
misreading of the counter. This can be corrected and
30 reconciled eventually.

 The basic software, unmodified, provides for
making reservations on a first in/first served basis by
title. Similarly, the software provides a put-away report
which flags returned cassettes to indicate that they are now
35 available for rental. The software is modified so that all
rental cassettes rented pursuant to the present invention
will be flagged and each unique cassette identification

1 number will be indicated together with the last cassette
counter reading.

Defaulting customers should be flagged as
delinquents. Delinquent customer files should remain in
5 memory. Thereafter, the software routine should
automatically search its records for the name of any new
customer to make certain that that name is not located in
the delinquent file. This prevents customers from taking
out new memberships when they are already delinquent.
10 Alternatively, a customer name list can be displayed so that
the existence of a file on that customer can be determined
visually by the clerk.

Preferably, any transaction such as overrides,
etc., which is contrary to normal store policy should be
15 highlighted on the screen of the computer 112.

COUNTING CASSETTES

Referring now to Figure 3, a video cassette
incorporating a built-in mechanical counter, well adapted
for use in the foregoing system, is illustrated. The video
20 cassette includes a casing generally referenced 1. The
cassette has a magnetic-tape guidance assembly 2, a delivery
reel hub 3 and a take-up reel hub 4. When a tape is played,
the diameter of the reel centered on take-up hub 4 increases
while that on delivery hub 3 simultaneously decreases. When
25 the tape has been fully played, it is rewound back onto
delivery hub 3. It might be noted that the distance "d",
that is to say, between the two reeled portions of tape at
any point of play, is not constant. At "half-way play"
position this distance is very slightly less than it is at
30 "full-play" or "start-of-play" positions. Moreover, the
distance "d" varies slightly between the "Beta" and "VHS"
systems and therefore the inventive counting device is
adapted to be able to be employed in both kinds of video
cassettes by selecting the minimum average distance for "d"
35 in respect of both systems.

The mechanical counting device of this embodiment
includes an arm 5 pivoted within casing 1 at a point 6

1 equidistant between hubs 3 and 4. Pivoted arm 5 terminates
in a camming head 7 and may be spring-urged to maintain it
in constant contact with the surface of the outer turn of
tape on hub 4, this contact being initially at the point 8
5 on broken circle 9 which represents the minimum tape
diameter on hub 4. To reduce frictional wear on the tape,
camming head 7 may include a wheel.

After commencement of play, the diameter of the
tape portion on take-up reel hub 4 increases and moves arm 5
10 through an arc indicated by the curved arrow 10. When a
predetermined number of degrees of arc has been traversed by
pivoted arm 5, this latter activates a trip means of a
counting mechanism to thereby indicate that the tape has
been played, or substantially played, on time. Ideally,
15 this count is initiated when, say, from about 50% to about
90% of the tape has run through. On the rewinding of the
tape back onto delivery hub 3, a ratchet-and-pawl assembly
may ensure that the "rewind" is not counted as being a
"play". Alternatively the trip means may be activated to
20 count both winds and re-winds, the pair of counts therefore
representing one play of the tape. In other words the
counting device will thus record the number of times that a
consumer has benefited by the playing of the video tape
cassette.

25 Figure 4 shows shows a suitable counting mechanism
which includes a planar cover plate 11 adapted to be
accommodated within a video cassette casing, as that
generally referenced 1 in Figure 3. In this embodiment the
arm is pivoted at point 12 coaxial with a counter-actuating
30 pawl member 13 which is arranged so as to rotate as the arm
moves through its arc in response to change in reel
diameter. When a predetermined number of degrees of arc has
been transversed, the tip of pawl member 13 contacts a tooth
of a peripherally-toothed counter ring 14 and counts one
35 play. When a hundred plays have been counted, a lug 15 on
the inner periphery of ring 14 meshes with a co-acting lug
on the periphery of a hundred-plays counter ring 16 which

1 may be adapted to count up to, say, 399 plays. On the
rewinding of the tape back onto the delivery hub, this
ratchet-and-pawl arrangement ensures that the "rewind" is
not counted as being a play.

5 In the further embodiment shown in Figure 5, the
device includes a pair of pivoted arms 17, 18 which operate
to measure the diameter of the reel of tape, a drum counter
19 moves accordingly on its axis of rotation 20 to count
plays.

10 Yet a further mechanical embodiment is to be seen
in Figure 6; here, a pivoted arm 21 senses the change in
diameter of the reel. Arm 21 is provided with a finger 22
adapted to engage with a tape 23 of a tape-counter device
24.

15 In another embodiment there is provided an
actuator assembly of the type illustrated in exploded view
in Figure 7. The actuator assembly is adapted to be housed
within the video cassette casing between the
delivery/take-up reels and the bottom face of the cassette
20 casing.

The actuator assembly/counter assembly comprises a
top cover plate 25 slidably engaged to a stationary or fixed
bottom cover plate 26. The top cover plate 25 comprises two
eccentric or elliptical openings 27 and 28 to allow for
25 movement of the top cover plate relative to the hubs of the
delivery and take up reels. Tongue members 29 and 30 on the
top cover plate are adapted to engage the elongate slot 31
in the bottom cover plate and help facilitate the top cover
plate's slidable engagement with the bottom cover plate.

30 On the upper face (not shown) of the top cover
plate 25 is arranged a frame 32 comprising two arcuate
members spaced from the outer periphery of magnetic tape on
the delivery and take up reels, said arcuate members being
rigidly connected via a bridging member axially aligned with
35 a notional line running through the axial centers of the two
reel hubs. The arcuate members are affixed to tab
extensions on the top cover plate. The arcuate members

1 contain spring plate members adapted to contact the outer
periphery of tape on either the delivery reel or the take up
reel. The whole top cover plate assembly or carriage is
thus adapted for movement as magnetic tape is transferred
5 from one reel to the other.

The counter assembly comprises a units counting
wheel 33 and a hundreds counting wheel 34, both with indicia
indicated adjacent the outer peripheral edge. The units
counting wheel comprises 100 slots 35 spaced 3.6° apart,
10 each slot except one being 3.0mm x 1mm, with the remaining
slot 36 being 8.0mm x 1mm; this latter slot allows for
engagement of the hundreds counting wheel when the units
counting wheel has passed through one rotation. The
hundreds counting wheel is provided with a series of five
15 slots 37 spaced 4° apart.

A series of six spaced tabs 38 about an inner
periphery of the bottom cover plate provide a bearing or hub
for the units counting wheel, and a further series of six
tabs 39 spaced outwardly therefrom provide a bearing or hub
20 for the hundreds counting wheel. The indicia on the
counting wheel(s), corresponding to the number of plays of
the video cassette are readable through window 40, which has
a corresponding window opening in the bottom face of the
video cassette casing.

25 The slots 35 to 37 of the counting wheels are
engaged by tongue means (not shown) depressed and depending
from the lower surface of the top cover plate 25. The
combination of these slots and the tongue means provides a
ratchet-and-pawl arrangement for rotation of the counting
30 wheels according to the number of plays. On the rewinding
of the tape back onto the delivery hub, this
ratchet-and-pawl arrangement ensures that the "rewind" is
not counted as being a play.

All components can be manufactured from plastics
35 material. In this embodiment, the top and bottom cover
plates, and the counting wheels, can all be fabricated from
0.08 polyester.

1

PREFERRED EMBODIMENT

5

Figures 2, 8, 9, and 10 show a preferred video cassette having caliper arms of the general type depicted in Figure 5 for sensing the change in diameter of the tape wound on the spool or reel.

10

Referring first to Figure 2, the video cassette includes a casing with a top wall 257, bottom wall 259, and a rear wall 255. As it is shown in Figure 8, the cassette has a magnetic tape guidance assembly 2', a delivery reel hub 3' and a take-up reel hub 4'. When a tape is played, the diameter of the tape roll 263 wound onto the take-up hub 4' increases while that on delivery hub 3' simultaneously decreases.

15

Now referring to Figure 8, in this preferred form, the counting device of the invention includes a pair of caliper arms, 17' and 18', which sense the changing diameter of the tape roll 263 on the take-up reel. Caliper arms 17' and 18' are spring-loaded inwardly against the outer surface 261 of the take-up roll by means of a spring 50.

20

25

The caliper arms 17' and 18' are pivotably mounted on a shaft 51 which as shown in Figure 12, is secured to the top wall 257 and bottom wall 259 of the casing 1'. As it is shown in Figure 8, the shaft 51 is located between the left ends of the caliper arms and the right ends 265 and 267 of those arms, which contact the outer surface 261 of the take-up tape roll 263. Thus, the spring 50 holds the caliper arms in contact with the tape roll 263 at all times, both when the tape roll is revolving as the tape is being played or rewound in a tape player, and also when the tape roll shifts laterally during movement of the cassette in transit.

30

35

As the caliper arms 17' and 18' are forced apart by the increasing diameter of the tape roll on the take-up reel, the counter 252 is driven so as to increase the count by one when the diameter of the tape roll 263 reaches a pre-determined value. This value typically is a fraction of the maximum diameter of the tape roll 263. Usually, this

1 fraction is greater than one half, but substantially less
than maximum diameter, so that one play will be counted when
a major fraction of a full length tape has been played.

5 The tape roll diameter-sensing mechanism shown in
Figure 9 is the same in function and operation as that shown
in Figure 8, but differs in some details. The operation of
both mechanisms now will be described by reference solely to
Figures 9 and 10 through 12.

10 The caliper arm 17' has a right end 265 with a
convexly curved bearing area 243 to ride on the surface of
the tape roll with minimum friction and wear, and a section
247 which is curved so as to ensure clearance between the
tape roll and the arm at all points other than the bearing
area 243 when the roll 263 is at its largest size. The
15 caliper arm 18' has a similar bearing area 243 and curved
portion 245.

The arm 17' has a mid section 248 and a left end
section 246. The arm 18' has a relatively wide mid section
242 and a left end section 241.

20 The spring 50 is a torsion spring wrapped around
the shaft 51 and is anchored at one end to a block 249
attached to the left end 241 of the arm 18', and at the
other end 244 to the left end 246 of the arm 17'.

As it is shown in Figure 10, the counter 252
25 consists of three counting wheels 55, 56 and 57 with
integral ratchet wheels 55', 56', and 57' rotatably mounted
on a shaft 60 which is secured at its lower end to the mid
section 242 of the caliper arm 18'. Figure 9 shows the
counter 252 with the top wheel 57 removed so that the
30 toothed ratchet wheel 57' is exposed to view.

As it is shown in Figure 9, a shaft 260 is secured
at one end to the mid section 248 of the caliper arm 17'.
Rotatably mounted on the shaft 260 are three actuating arms
52, 53 and 54. Only arm 54 is visible in Figure 9, but all
35 three arms are visible in Figure 10.

Each of the arms 52-54 has a left end projection
240 (Figure 9) and a toothed right end 239. A leaf spring

1 15 is secured at its left end to the mid-section 248 of the
caliper arm 17'. The right end of the spring 15 bears
against the projections 240 and urges each of the arms to
rotate clockwise about the shaft 260 and thus urges the
5 toothed end 239 of each actuation arm against its
corresponding ratchet wheel.

Referring to both figures 9 and 10, a
three-pronged leaf spring 58 is secured at its left end to
the mid section 242 of the caliper arm 18'. Each of the
10 three prongs of the spring 58 bears against one of the three
ratchet wheels 55', 56' or 57' and acts as a stop to prevent
rotation of the ratchet wheel backwards, thus ensuring that
the count of the counter will only increase.

The three number-bearing wheels 55-57 and their
15 respective ratchet wheels 55'-57' are identical to one
another. Each ratchet 55'-57' has ten teeth. Wheel 55
counts digits; wheel 56 counts once every ten digits; and
wheel 57 counts once every hundred digits. Thus, the
counter 252 can count up to 999 before being reset to zero.

20 As it is shown in Figure 10, each wheel 55-57 has
a notch 55a or 56a or 57a which forms a ratchet tooth in its
upper edge.

When the tape is played, the diameter of the tape
roll 263 increases and the caliper arms are spread apart.
25 As this happens, the arm 52 tangentially pulls against a
tooth on ratchet wheel 55' to rotate the wheel 55 by the
distance of one tooth to record a count of one. Arm 53
similarly is urged toward the ratchet teeth on the "10's"
numeral wheel 56, but rides on the upper edge of wheel 55
30 and is thus prevented from entering the ratchet teeth of the
ratchet wheel 56 to pull the wheel 56 forward one notch
until the toothed end of arm 53 falls into the one ratchet
tooth 55a on the upper edge of wheel 55. This occurs every
ten digits. The same mechanics then apply to arms 53 and 54
35 and wheels 56 and 57, except that actuating arm 54 includes
a lug 59, which rides on the back of actuating arm 53. This
means that actuating arm 54 will not engage a tooth on wheel

1 57 until actuating arm 53 simultaneously engages a tooth on
wheel 56. Therefore the wheel 57 remains stationary through
the "90's" of any one hundred digits until it reaches "99",
when all actuating arms mate with teeth so that all three
5 counter wheels 55, 56 and 57 advance one notch
simultaneously.

When the tape is rewound and caliper arms 17' and
18' are free to move inwardly, the actuating arms 52, 53 and
54 reset into the next ratchet tooth, as allowed by the
10 single ratchet 55a-57a on adjacent counter wheels. The
spring projections 58 prevent reverse rotation of the
counter wheels.

The process will then be repeated as additional
plays are counted.

15 The counter is adjacent the back edge 255 (See
Figure 2) of the cassette, and its count can be read through
the window 253. The window 253 preferably includes a
magnifying lens.

As it has been noted above, the preferred counting
20 mechanism discussed above is highly advantageous in that the
mechanism prevents false counting due to shifting of the
tape reels in the casing or housing 1'. The reason for this
is that the counter mechanism detects only differential
movement by the caliper arms. This is due to the fact that
25 the counter mechanism 252 is mounted on one of the caliper
arms and the actuating arms 52-54 are mounted on the other.
Thus, only rotation of the caliper arms away from one
another drives the counter. There-
fore, if the take-up spool moves in the direction X shown in
30 Figure 8, the caliper arms 17' and 18' both rotate about
shaft 51 by approximately the same amount, since each arm is
urged against and follows the outer surface of the roll 263
of tape on the take-up reel. Since this causes no
differential movement of the arms, the counter mechanism is
35 not driven.

Since both of the caliper arms bear against the
tape roll at about its greatest dimension, any movement of

1 the roll in the "Y" direction creates negligible
differential movement of the caliper arms and no false
counting.

5 Another advantage of the use of the caliper arms
is that because the diameter of the tape roll 263 is
detected instead of the radius, the motion created by a
given amount of tape motion is twice the relative motion
created when only one roll size detector is used. This
increase in motion constitutes an improvement over such
10 systems as disclosed in either United States Patent Nos.
4,466,584 or 3,995,319, since the devices disclosed in these
patents are capable only of detecting the radius of the tape
wound on the spool. Thus, the present invention provides
for simpler, more direct and more accurate counting.

15 SPOOL BRAKE

The video cassette of the present invention
preferably includes a new spool brake assembly of inventive
design to fit the restricted space in the cassette. With
reference now to Figures 8, 13, 14 and 15, the spool brake
20 80 includes arms 81 and 82, which pivot on a post 83 which,
as it is shown in Figure 14, is formed integrally with the
bottom wall 259 of the cassette housing.

The upper end of the post 83 fits into a hole 91
in a boss 92 extending downwardly from the top wall 257 of
25 the housing 1'. (Neither the top wall 257 nor the bottom
wall 259 is shown in Figure 13).

As it is shown in Figures 13 and 14, arms 81 and
82 pass over each other in scissor-like fashion. The ends
of the arms form teeth 88 and 89 shaped to engage the
30 sprocket teeth or castellations 90 (Figure 8) in the edges
of the base disks of each of the tape spools. Arms 81 and
82 are urged by a torsion spring 84 away from one another
and into engagement with the teeth 90 so as to engage the
brake 80 and prevent the tape spools from rotating while the
35 cassette is outside of a tape player.

As it is shown in Figures 13 and 14, a hole 191 is
provided in the bottom wall 259 of the cassette housing.

1 Aligned with the hole 191 is a hole 93 between the arms 81
and 82. The lower edge of the hole is beveled at 85 to
facilitate insertion of a pin into the hole 93.

5 When the cassette is loaded into a VCR machine, a
brake deactivating pin 87 in the VCR is inserted into the
hole 191. The diameter of the hole 93 is substantially less
than the outer diameter of the pin 87. Therefore, the pin
87 wedges the brake arms apart. This holds the teeth 88 and
89 away from the spools and keeps the brake disengaged while
10 the cassette is in the VCR. The brake 80 permits rotation
of the spools only when the cassette is inside a VCR.

While the foregoing description has been couched
in terms of mechanical counting, counting may nevertheless
be achieved electro-mechanically, electrically
15 electronically, or, indeed, by any feasibly means. For
example, the inventive device may utilize the crenellations
that are provided on a tape reel to facilitate braking
operation; a capacitive sensor and an IC Logic chip sense
movement in a particular frequency band which covers the
20 range of speed consistent with play mode. Rewind frequency
produces the signal to provide a null or unity input. Upon
threading tension, a second sensor energizes the circuit. A
timer chip pre-set to program duration is triggered by the
logic chip and times out the total play frequency duration,
25 producing a threshold signal to display via the logic chip
adding the appropriate count to the display when the
cassette is rewound or removed from the cassette player.
The total tape plays are recorded and/or displayed for the
hire period and the progressive total for the cassette is
30 stored for retrieval by the owner.

Memory output may be visual or electronic however,
preferred is direct reading by computers. When a cassette
is returned and "plugged in" to the shop's computer which
outputs data like title, number of plays, etc. The computer
35 calculates hire charge from data on royalty, cost recovery
or the like. Hirer's account is debited and royalty

1 transferred. Total tape wear is accurately known since
total footage past the heads is known.

ELECTRONIC COUNTING/READOUT

5 Figure 16 is a schematic diagram of an electronic
counting and readout system 270 which detects the tape roll
size changes, converts those changes into play counts,
stores those counts electronically and displays them
electronically in a machine-readable format. The count can
10 be read into one of the rental computers 112 by means of a
bar code reading "wand" 290. If desired, the mechanical
counter also can be used to give a count readable by humans.

The means used to detect the tape roll size
changes is that described above and shown in Figures 8-12.
This mechanism drives the mechanical counter 252 (Figure 2)
15 to give a count which can be read by humans. In addition,
mounted in the cassette housing 1' are a pair of switch
contacts 272 and 274, a CMOS microprocessor chip 280, an
EEPROM chip 284, a battery 282, a switch 286 and a
light-emitting-diode ("LED") array 288.

20 The spring arm 58 which is used to prevent reverse
rotation of the "units" ratchet wheel 55' (also see Figure
10) is used as a flexible contact member which acts with the
contacts 272 and 274 to produce an electrical
count-indicating signal and deliver that signal over lines
25 278 to the microprocessor 280. When the arm 58 is fully
engaged in one of the notches in the ratchet wheel 55, it is
at its uppermost position and makes contact with contact
272.

30 As the ratchet wheel 55' rotates, the tooth 276
against which the arm 58 bears starts to bend the arm 58
away from contact 272. At the position shown in Figure 16,
the arm does not make contact with either contact 272 or
274.

35 At a pre-determined position, e.g., three-fourths
of the way through its downward deflection, arm 58 reaches
contact 274. The microprocessor 280 is programmed to have
an "AND" function at its input so that a count signal is

1 developed only when two signals have been received due to
the opening of contact 278, and the other due to the closing
of contact 274. The microprocessor is programmed to count
these signals and store the count in the EEPROM. The count
5 is sent over a line 283 to a LED array 288 which converts
the count into a pattern readable by the bar code reader
wand 290.

The LED array 288 also displays the cassette
identification information which is permanently stored in
10 the EEPROM 284. Thus, the array 288 displays both the
identification information and play count in
machine-readable form so that both sets of data can be read
with a single application of the bar code reader wand 290.

The LED array 288 emits light of the same
15 wavelength as that emitted by the wand 290. The LED array
forms in a pattern which simulates the alternating light and
dark bands sensed by the wand when it sees an ordinary bar
code.

Because the battery 282 should be small and should
20 last a very long time without replacement, the
microprocessor 280 is programmed to disconnect the battery
282 automatically when it has not received an input signal
for a certain length of time, indicating that the cassette
is not being played or scanned. However, the data stored in
25 the EEPROM 284 is not lost and remains stored even after the
power is turned off. The contacts 272 and 274 remain
energized at all times, but create no power drain unless the
microprocessor is powered up.

When one of the switch contacts 272 and 274 is
30 opened or closed, the microprocessor powers up and is ready
to operate.

A switch 286 is provided in the cassette to
power-up the microprocessor when it is desired to read out
the count, etc. from the cassette. The switch 286 can be a
35 simple pressure-operated switch which is accessible at the
outside of the cassette and can be operated by simply

1 pressing it with a finger, pencil, or the tip of the wand
290, or any other handy object.

Alternatively, the switch 286 can be a photo-cell
switch operated in response to receipt of light emitted by
5 the wand 290.

It should be understood that the system 270 makes
a separate character reader 111 (Figure 1) unnecessary for
reading the count into the computer 112 because a single bar
code reader 116 will suffice.

10 The above described electronics can be run on a
watch battery or rechargeable cell.

Figures 17 through 23 show the preferred form of
the electronic counting/readout device and method of the
present invention.

15 Figure 17 is a partially schematic cross-sectional
view of a portion of a video tape cassette 300, with the
section being taken through a take-up or dispensing reel 306
in the cassette.

The reel 306 is a unique device which not only
20 stores and dispenses recording tape, but also contains
integral means for electronically counting the number of
plays of a program on the tape, and providing a bar-coded
output of that and other information.

The cassette 300 includes a housing which has a
25 bottom wall 302 and a top wall 304. The bottom wall has a
hole through which the hub 311 of the tape reel is
accessible from outside of the cassette. The hub 311 has a
socket or receptacle 312 with splines which engage with
similar splines in a drive spindle in the tape
30 recorder/playback unit. The drive socket, spindle, and
recorder/playback unit are conventional.

The tape reel 306 has a lower flange 308 and an
upper flange 310 secured together by means of the hub 311.
A relatively small amount of tape is shown wound on the hub
35 at 314.

1

ELECTRONIC PLAY COUNTING

Fig. 18 is a perspective view of a counting module 316 which is built into the tape reel 306. The unit 316 consists of a thin printed circuit card 318 with an arm 320 having a light source 322 and two light sensors 324 and 326 mounted on the arm at radially spaced-apart locations.

The operation of the counting module 316 is as follows. Light from the light source 322 shines downwardly and is reflected off of the bottom flange 308 upwardly to the sensors 324 and 326. When the roll of tape 314 grows to a size such that it covers the innermost sensor 326, light cannot reach it. This primes the detecting circuitry so that when the tape roll grows enough so that the second sensor 324 is blocked, the electronic circuitry (to be described below) indicates one count. This count is counted and stored in an electronic counter formed by the circuitry mounted on the board 318. The circuitry includes an EEPROM chip 338, and a microprocessor chip 336, as well as other circuitry to be described below.

Although the lamp and the sensors could be located in opposite flanges, with the lamp 322, for example, being located in the upper flange, and the two sensors 324 and 326 located in the lower flange 308, the present arrangement is advantageous in that it locates all of the sensors on a portion of the same circuit board as that used for the LED 334 and other circuit components. Also, all of the sensors are located in the upper flange where debris from the tape will not fall onto the sensors or the lamp and thus impede their operation.

The counting module also can be operated in the reverse manner, where the emptying of the tape from the reel, rather than the accumulation of tape, causes the detection of one count.

CODED READOUT

As it is shown in Figures 17 and 18, located at the center of the circular portion of the card 318 is a pressure-sensitive switch 329 and an output LED 334.

1 As it is shown in Figures 17 and 19, the pressure
switch 329 has a flexible lower plate 330 with a central
hole giving visual access to the LED 334 which is aligned
with the hole. A contact ring made of conductive material
5 331 is attached to the underside of the bottom plate 330. A
second contact ring 332 is attached to the circuit board
318. The dimensions of the contact rings are such that
normally they are spaced apart. However, as it is shown by
Figure 19, when the tip 340 of a bar-code reading wand is
10 inserted into the cavity 312 and into the LED access hole,
and is pressed against the edges of the bottom plate 330,
the plate flexes inwardly so that the conductive rings 331
and 332 make contact with one another. This enables the
electronic circuitry to supply a series of timed pulses to
15 the LED 334. This series of timed pulses simulates the
scanning of a bar-code.

 The code which is thus read out indicates the
total number of times the tape in the cassette has been
played, as well as other information regarding the cassette
20 and the program on the tape, as in the device shown in
Figure 16 and described above.

 The bar-code reading wand is conventional. By
enabling the count of the counting device to be read-out
with a simple bar-code reading wand of the type that
25 typically is used in point-of-sale terminals, the count of
the number of plays of the tape can be entered into a
point-of-sale computer at the video rental store without
manual keyboarding. All that the operator need do is insert
the wand tip into the drive socket hole briefly when it is
30 returned. This simple procedure is all that is needed to
enter into the computer the beginning and ending counts, and
enable the computer to compute the per-play fee due from the
customer.

 Certain proposed prior art electronic play
35 counting devices suffer from the defect that they need a
plug or other electrical connector to make electrical
connections to an outside device which senses the count in

1 the cassette. This electrical connector is believed to make
it possible for any user or vandal to send electrical
signals into the cassette and destroy its counting
components or cause it to give a false reading.

5 The present invention overcomes this defect by
providing a light output which can be read only by a
bar-code reading wand, so that electrical access to the
electrical components in the housing is not permitted.

The read-out of the count is extremely simple,
10 merely requiring the check-out clerk to press the tip of the
wand into one of the sprocket holes of the cassette. This
may be even simpler than wiping the wand across a printed
bar-code on the outside of the cassette. Of course, the
printed bar-code cannot be changed, whereas the count output
15 by the LED 334 is changed electronically each time the
cassette is played.

The arrangement of light sensors and lamp in the
counting module 316 is highly advantageous in that the
entire assembly, including lamp and sensors and connecting
20 circuitry, is mounted on a thin printed circuit card which
is fitted into a molded recess in the upper flange 310 of
the tape reel 306.

Not only does this make the counting device very
compact, but it provides a unique tape reel with the ability
25 to give a machine-readable output indication of the count of
the number of program plays, and other information regarding
the tape and/or the program recorded on the tape. This is
highly advantageous in that the reel will fit into a
standard cassette housing so that manufacturers will not
30 have to modify the usual video tape cassette except by
substituting the counting reel for one of the conventional
reels. This reduces manufacturing costs and resistance to
adoption of the counting of plays in the rental of video
cassettes.

35 Figure 20 is a cross-sectional view of a portion
of a preferred embodiment of the tape reel structure of the
invention.

1 The bottom flange 308 and the hub 311 of the tape
reel 306 are molded as a single part, and the upper flange
310 is molded separately. Both parts are made of
polystyrene.

5 Integral with the lower flange 308 is a vertical
wall 307. A boss 325 extends between the upper and lower
parts of the tape reel. It is ultrasonically welded to hold
the two parts of the tape reel together.

 A metal bearing member 337 has a frustro-conical
10 outer edge which fits into a hole in the upper flange 310
having a similar shape. The bearing member bears against
the usual spring 328 (part of which is shown in Figure 17)
when the reel is thrust upwardly by the spindle 343 of the
VTR, thus providing a low-friction bearing for rotation of
15 the reel in the cassette. The output LED 334 is secured to
the printed circuit board 318 by means of solder 353. The
printed circuit board 318 is mounted in a molded recess in
the upper flange structure.

 The hub 311 consists of a lateral portion 313 and
20 a vertical portion 315 with an annular flange or ledge 317
forming a receptacle and stop member for the pressure switch
plate 330. The plate 330 is made of brass and has a
sharp-edged ring-shaped contact member 31 projecting towards
the printed circuit board 318. A high density resilient
25 foam rubber ring 319 urges the plate 330 away from the
printed circuit board 318 and against the flange 317 to hold
the pressure switch open until it is depressed by pressure
from a bar-code reading wand.

 A bar-code reading wand 342 with a tip 340 and a
30 lens 341 in the tip are shown in Figure 20 in or near
operating position when data is being read out of the
cassette. The wand tip 40 is shown in two different
positions near or contacting the pressure switch.

 The portion of the drawing to the left of the
35 centerline 335 in Figure 20 shows the pressure switch and
wand in the positions they reach when the pressure switch is
closed by pressure from the wand. The portion of the

1 drawing to the right of the centerline 335 shows the
pressure switch and the wand when the wand has been moved
slightly away from the plate 330, and the pressure switch.
The foam ring 319 is shown compressed to the left of
5 centerline 335, and is shown extended to the right of that
line.

The central aperture in the pressure switch plate
330 has a beveled entrance edge 351 which guides the tip of
the wand to the proper location to receive light from the
10 LED 334; a location in which the centerline 335 and that of
the wand are aligned. The LED 334 is symmetrical with
respect to the centerline 335 so that the rotary position of
the reel 306 does not affect the read-out by the wand.

As it is shown in the right-hand portion of Figure
15 20, the tape reel construction forms an annular cavity 321
into which is inserted a battery 323. Another battery (not
shown) like the battery 323 is located in the cavity 321
approximately 180° from the battery 323 so that the tape
reel will be rotationally balanced. The battery 323
20 preferably is a very long-life 6 volt lithium battery of the
type used in watches. Because of the special features of
the invention insuring low battery power drain, it is
believed that, in the normal course of events, the battery
will have several years of life, the life being
25 approximately equal to that of the tape cassette it is used
in.

Shown in dashed lines in Figure 20 is a spindle
343 inserted into the hub 311 to drive the tape reel. The
spindle 343 is, of course, a part of the recording and
30 playback unit into which the cassette 300 is inserted.

The reel shown in Figure 20 also has the tape
detector structure shown in Figure 24 and described below.

As it has been noted above, the bar-code reading
wand 342 is conventional. A particular model which has been
35 successfully used in a embodiment of the invention is the
Hewlett Packard Model HBCS-2500. The general structure of

1 such a wand 342 is illustrated schematically in Figure 22,
which is a cross-section taken through the tip of the wand.

The printed bar-code 344 which the wand is
designed to read is shown beneath the tip of the wand 342.
5 It consists of a series of black stripes of varying width
and white spaces between the stripes. When the wand is
moved across the bar-code pattern 344 in the direction of
the arrow W in Figure 22, light from a lamp 347 travels
through a conduit 345, 349 to the tip of the wand where it
10 is focused by the lens 341 on to the bar-code pattern. Any
light reflected from the pattern back to the wand is
transmitted back up through the passage 349 and another
passage 346 to a photodetector 348. The amount of light
reflected by a white space is very large and that reflected
15 by a black line is relatively low, so that the photodetector
348 produces timed pulses of varying widths and spacings in
response to being scanned across the bar-code pattern 344.

Figure 23 shows schematically the electrical
components of a typical bar-code reading wand useable with
20 the present invention. The components shown in the wand tip
in Figure 22 comprise an optical sensor 350. The output of
the optical sensor is delivered to an analog amplifier 352
into a digitizer 354 which digitizes the signals it
receives.

25 An output driver transistor 356 and capacitor 358
are provided at the output of the digitizer and the optical
sensor 350. The output signals are delivered through a
cable 360 and a conventional bar code interface unit 361 to
a computer 112 used at the rental store (see Figure 1).

30 Figure 21 shows a preferred operating circuit 370
of the present invention.

As it is shown in Figure 24, in the preferred
embodiment, instead of having a single lamp 322 and two
detectors 324 and 326 as shown in Figure 18, each detector
35 324 and 326 consists of a pair of side-by-side elements
including a light-emitting diode and a sensor. Unit 324
consists of an LED LD2 and sensor S1, and unit 326 consists

1 of an LED LD3 and sensor S2. Each light emitting diode has
a small integral lens 361 which is used to focus the light
from the diode into a narrow beam, most of which, when
reflected back to the sensor S1 or S2, is concentrated on
5 the sensor and is available for switching purposes. This
enhances the efficiency of operation and minimizes power
drain on the battery.

Now referring to Figure 21, the components used in
the circuit 370 are given the same reference numerals as
10 those used when describing them above. In addition, other
symbols are used for some of these elements. The pressure
switch 329 thus is also labeled "SW1". Similarly, the
micro-processor or micro-controller 336 also is labeled "U1"
and the EEPROM or E2PROM 338 is labeled "U2". The output
15 light emitting diode 334 also is labeled LD1.

LOW POWER DRAIN OPERATION

To prolong battery life, the micro-controller U1,
memory U2, and sensors S1, S2 are normally turned-off.
Power from the battery 323 is switched to these components
20 by p-channel vertical D-MOS transistor Q3. Switching of Q3
is effected in two ways:

One way is by closure of the pressure switch 329
(SW1) when reading information out. This charges capacitor
C1, causing the gate voltage of Q3 to fall below the source
25 voltage long enough for Q3 to energize the micro-controller.

The second way is by regular intermittent
operation to check on the size of the tape roll to see if a
count should be registered. On a regular set interval (2 to
3 minutes) n-channel MOSFET Q1 is turned on as its
30 gate-source voltage rises under the control of RC timer
network R2-C2. When Q1 turns on, it lowers the gate voltage
of Q3, allowing it to switch on and power up the
micro-controller. C3 applies positive feedback to speed the
switching process.

35 When powered on, the micro-controller (U1)
executes its internal program. Its first operation is to
output a positive signal on G3 (pin 14) which will turn on

1 n-channel MOSFET Q2. This now holds the gate of Q3 low,
ensuring continuity of the power delivered to the
micro-controller. Q2 now also discharges the capacitor C2
in the RC timer network via R3 and diode D4.

5 Although the pressure switch SW1 may have
initiated the power on cycle, and though it may remain
closed, because it is capacitively connected via C1, it
cannot maintain the power connection to the
micro-controller. The maintenance of this connection is
10 controlled by the micro-controller itself via output G3 and
MOSFET Q2. When the micro-controller has completed
execution of its internal program, it turns off its own
power by opening the connection to G3.

The time interval of 2-3 minutes between
15 intermittent operations is a function of the power
consumption of the device, the battery capacity, and the
desired battery life, as well as the speed at which a tape
roll grows or shrinks in the cassette at normal playing
speeds. Ideally, if the battery drain were not too great,
20 it would be desired to set the time interval as low as
possible. However, the time period cannot be so great that
it causes the device to miss a play count or to miss the
indication of a rewind condition to indicate that the tape
has been rewound. Thus, the time interval should be
25 somewhere between a few seconds and around 5 minutes, with 2
to 3 minutes being a reasonable compromise.

As an option, another improvement in battery life
can be obtained by utilizing a switch 372 formed by or
located adjacent the spring 328 (Figure 17) which is located
30 within each video tape cassette. The switch 372 will be
closed if and only if the cassette is located in a tape
player and the drive spindle is inserted into the hub of the
reel. This lifts the reel in the cassette and closes the
switch 372. With this arrangement, there would be no
35 operation or power drain until the cassette is inserted into
a player.

1 Tape Detection Circuitry

Whenever the micro-controller is turned on, the two light-emitting diodes LD2 and LD3 are energized through a current-limiting resistor R11 and an switching transistor Q4 whose base is connected through resistor R6 and diode D2 to the pressure switch 329, and to the micro-controller output lead L0.

Referring again to Figure 18, one of the LED-sensor pairs 326 is located relatively close to the hub of the reel 306, and the other pair 324 is located radially outwardly from the pair 326. The pair 26 is located at a position such that it detects the condition in which the reel is about 10% full, and the pair 324 is located to detect when the reel is about 70% full.

Under control of the micro-controller output L0 (pin 6) transistor Q4 turns on LED's LD2 and LD3 for about 50 micro-seconds. During this 50 micro-second "flash", sensors S1 and S2 are read by micro-controller input lines L1 and L2 (pins 5 & 4). If no tape occludes the light path from either LED to its neighboring sensor, the sensor will give a positive output signal.

The sensor output signal levels have the meanings set forth in the following truth table:

25	S2 S1		<u>MEANING:</u>
	0	0	The reel is less than 10% full
	1	0	The reel is more than 10% but less than 70% full
	1	1	The reel is more than 70% full

30 The micro-controller is programmed to act as a count signal generator and counter. A typical count cycle performed by the programmed micro-controller is:

35	a)	0	0	less than 10% - store a "rewound" bit in the E2PROM
	b)	1	0	more than 10%, less than 70% - do nothing
	c)	1	1	more than 70% - add a count to the total

1 stored in E2PROM, if and only if,
rewound bit has been set, then erase
rewound bit from E2PROM memory
5 d) 1 0 less than 70% - do nothing
e) 0 0 return to a) (record a "rewound" bit to
indicate the start of another count
cycle)

The use of two radially spaced-apart sensors helps
10 to insure valid counting; that is, to make sure that a count
is not recorded when the program is only partially played,
and that one count is recorded whenever at least 70% of the
program has been played. The following examples show how
the two sensors operate in conjunction with one another to
15 achieve this end.

For example, assume that the tape from the rewind
(less than 10%) position, plays forward to the position 10%,
stops, rewinds to the 5% position, plays forward to the 70%
position, plays back 10%, plays forward to the end of the
20 program, and rewinds. This is, in effect, a single play.
With two sensors and suitable logic this will create a
single count. With only one sensor this might count two or
three plays, depending on sensor position.

Even with a single forward play, as the tape roll
25 slowly grows on the reel and slowly covers either sensor,
there will be a period when that sensor's output is
ambiguous. The ambiguity even could be worse if the
recorder/player pauses at a marginal sensor position.

Two sensors and the above-described circuit and
30 program prevent this ambiguity from causing a false reading.

An improved counting method is one in which the
micro-controller is programmed so that it will recognize
that the 70% sensor has been covered and a play has occurred
if and only if the sensor has been covered for more than one
35 sampling period; e.g., 3 successive periods of 2 to 3
minutes each, for a total of 6 to 9 minutes. This allows
the user of the cassette to run the tape in the fast forward

1 and fast rewind modes without creating a count. Since the
70% point is reached in most feature-length movies (e.g.,
100 minutes long) well before the end, there is plenty of
time before the end of the film for the count to be
5 recorded.

Memory

The memory unit U2 is a non-volatile memory; that
is, the data which is stored in it is retained indefinitely
unless it is erased. It is called an "E2PROM" or an
10 "EEPROM", which stands for "Electrically Erasable
Programmable Read-only Memory". Accordingly, the data input
and stored in the memory can be erased by the application of
electric signals.

The memory U2 is used to hold the serial number of
15 the cassette, the current cassette "count", and the serial
number identifying the cassette, the program in the tape,
etc.

The memory U2 also is used to store the status of
the sensors S1 and S2 while the power is off. That is, the
20 memory stores a digital 1 or 0 for each sensor to represent
its logic state when the power is turned off. This
information is used when the circuit next is energized to
aid the micro-controller in deciding whether to do nothing,
create and store a count, or to store a "rewound" bit in the
25 memory U2.

A memory which has been used successfully in a
circuit which has been built in accordance with the present
invention is a NMC9306 256 bit sequential access memory. It
is fabricated using advanced floating gate n-channel E2PROM
30 technology.

The device contains 256 bits of read/write memory
divided into 16 registers of 16 bits each. Each register
can be serially read or written to by the micro-controller.
Written information is stored in a floating gate cell which
35 will retain the information for at least 10 years. The
NMC9306 has been designed to meet applications requiring up
to 10,000 erase-write cycles per register.

1 Data is stored in the memory U2 as follows:

Register #

	0	four most significant binary-coded-decimal "(bcd)" digits of serial number
5	1	next four bcd digits of serial number
	2	next four bcd digits of serial number
	3	spare for future use.
	4-16	play count and switch status

10 Each of registers #4-16 holds a play count value and switch status. These registers are written cyclically with ascending counts as plays occur. The top bits of each register hold the previous sensor statii.

15 Registers are written into cyclically because each individual register is guaranteed for only 10,000 erase/write cycles; cycling through all of the twelve registers in turn increases the total number of guaranteed erase-write cycles to 120,000.

The Micro-Controller and Internal Program

20 The preferred micro-controller is the model COP411C. It is a fully-static, single-chip micro-controller fabricated using double polysilicon-gate CMOS technology. This micro-controller contains all system timing, internal logic, ROM, RAM, and I/O (input/output circuitry) necessary to implement dedicated control functions. Its features

25 include:

- . Low power dissipation (40 uW).
- . Powerful instruction set.
- . 512 x 8bit ROM. 32 x 4 bit RAM.
- . 16 I/O lines.
- 30 . Two level subroutine stack.
- . DC to 4 usec instruction time.
- . Single supply operation (2.4 to 5.5v).
- . Compatible serial I/O to E2PROM.
- . LSTTL/CMOS compability in and out.

35 When the micro-controller is turned on, either by the pressure switch SW1, or by the periodic timer, the internal program operates in the following matter:

- 1 . Output a high signal to line G3 (pin 14) to hold
 the power on;
- . input data on lines LO.1.2, reading status of SW1
 and tape sensors S1 and S2;
- 5 . if SW1 is closed, go to [B]; otherwise;
- . parse through the registers in the E2PROM U2,
 determine the register containing the latest
 count, and check the previous sensor data versus
10 . the current sensor data. If there has been no
 sensor change, go to [C]. If there has been a
 sensor change, update the E2PROM to record this.
 If the sensor change indicates a completed 'play',
 increment the count and write the latest count and
 sensor data to the next cyclic location in the
15 . E2PROM;
 go to [C].
- [B]
- . Input the cassette serial number from the E2PROM;
- . convert each digit of this to a 3 of 9 bar-code
20 . pattern (see below) and transmit this pattern by
 outputting it in a timed serial manner to output
 line G1;
- . parse the E2PROM and find the most up-to-date
 count, convert this count to 3 of 9 bar-code
25 . pattern and output it to line G1;
 go to [C].
- [C]
- . Output a low signal on line G3 to turn the power
 off.

30

Encoding

The micro-controller is programmed so as to convert signals read out of the memory U2 into signals which will simulate a bar-code being read by a wand. In order to understand this aspect of the invention, some discussion of bar-codes and the reading of bar-codes with wand readers now

35 will be given.

1 In a bar-code such as the printed code pattern 344
shown in Figure 22, data usually is stored in the form of a
series of alternating dark and light lines and spaces. The
codes usually are printed on a label or document.

5 There are many ways data can be encoded and
formatted within a printed pattern. However, the preferred
method chosen for use in the invention is the well-known
'standard 3 of 9 code' described below.

Standard 3 of 9 Code

10 This alphanumeric bar-code has characters
consisting of 5 bars and 4 spaces for a total of 9 elements.
3 of these elements are wide, hence the name "3 of 9". Wide
elements are equal to a binary one (1) and narrow elements
are equal to a binary zero (0).

15 A specific ratio of the widths of the wide and
narrow elements is used to distinguish the wide and narrow
elements from one another. Depending on the resolution
used, the wide element should be 2 to 3 times wider than the
narrow element. All narrow elements should be of equal
20 width, and all wide elements also should be equal in width.

 The 3 of 9 code is a discrete code, meaning there
is a space between each character. The width of this space
is approximately equal to the width of the narrow element.
25 This code is self-checking.

The Barcode Reading Operation

 Referring again to Figure 22, to read a bar-code
with a wand such as the wand 342 (Figure 22), the wand is
placed on the paper at the white margin at either side of
30 the bar-code symbol. The wand is then "whisked" smoothly
and lightly through the entire printed pattern in the
direction "W" without lifting it from the surface, as though
lightly drawing a line through the bar-code with a pen.

 When the wand is first placed on the paper, the
35 light from the lamp 34 is reflected from the white surface
and is sensed by the detector 348 in the wand, giving a
logic low level output. As the wand is scanned across the

1 bar-code, the output from the detector 348 goes high when
there is little radiation reflected from the pattern due to
passage of the wand over a dark bar or strip, and returns to
a low level when the wand passes over a white space which
5 reflects much more radiation back to the detector than the
dark bar.

In this manner a bar-code is translated to a
serial pulse train of high and low signal levels, the
duration of each pulse representing the width of the code
10 element.

Referring again to Figure 20, when the wand is
inserted into the reel hub, it is guided by the sloping
surface 351 into alignment with the centerline 335 with its
lens 341 near the LED 334. The outer surface of the LED is
15 non-reflective so that the light from the emitter 347 in the
wand is not reflected back to the photodetector 348.
However, light from the LED 334 is transmitted directly
through the tip of the wand onto the wand's detector 348.

As the wand 342 is pushed towards the LED 334, the
20 wand tip closes the pressure switch 329 (SW1 in Figure 21)
which powers the micro-controller which then develops a
pulse train representing the data to be read out and sends
the pulses to the LED 334. The wand receives the optical
pulses from the LED as if it were receiving reflected light
25 from a bar-code pattern it is scanning. The pulses are
timed by the micro-controller to match the pulses received
from a printed bar-code when scanned at normal speeds. The
scanning operation is further emulated by first turning on
the LED 334 for a time before transmitting the pulses. This
30 simulates exposure of the wand to a white margin next to a
printed bar-code.

In encoding the signals, the standard 3 of 9 code
is used.

The data transmitted consists of 18 digits:
35 1 start digit (*)
12 digits of unique cassette serial number
1 separator character (-)

1 3 digits of 'count' value
 1 end digit (*).

Each digit is converted to a discrete 9 element code by the micro-processor prior to transmission.

5 Lamps and Sensors

The specific emitters LD2 and LD3 (Figure 21) are PN gallium arsenide infrared emitting diodes capable of continuous power output of 2.5 mW. Each produces a narrow spatial radiation pattern created by the lens 261 (Figure 10 24) molded into its package. The wave length of its output is 940 nm.

The sensors S1 and S2 are opto-electronic switches providing light detection and low-level signal processing in a single 3-lead package. The monolithic integrated circuit 15 requires no external components. Its high sensitivity makes it ideal for low level light detection.

Each opto-electronic switch includes a photo diode, a high-gain current amplifier, a comparator with 12% hysteresis, an output driver stage and a voltage regulator. 20 The sensors turn on (produce an output signal) as illumination of the photo diode falls below 55 uW/CM^2 at 880 nm. An internal latch provides the hysteresis. The hysteresis insures that the output turns off when illumination surpasses the turn-on threshold by 25 approximately 12%.

A number of different light emitting devices are suitable for use as the output LED 334. The device should be chosen as much for its power and physical size as for its output wavelength.

30 Though a emitter will output light of a very specific wavelength, the optical detector 348 (Figure 22) in the wand 342 detects light across a fairly broad band.

The detector 348 gives its peak output when receiving radiation at approximately 820 nm. However, its 35 75% output is around 940 nm on the long side and 700 nm on the short side of peak output wavelength.

1 A switch emitter LD2 or LD3 is either a 930 nm PN Gallium Arsenide infrared-emitting diode or a 700 nm GaAsP red/infrared emitting diode.

VARIATIONS

5 There are a number of meritorious variations in the devices or their uses, in addition to the variations mentioned above.

For example, instead of using a light or other radiation emitter to simulate the reading of a bar-code, one
10 can use a device such as a liquid crystal display ("LCD") to create an array of dark and light bars in a bar-code pattern. The array 228 in Figure 16 can be considered to be such an array. Alternatively, one can use an LCD to create a single spot whose reflectivity varies with the signals in
15 a pulse train to alternately simulate the dark and light lines or bars. This device 334 in Figures 17-20 can be considered to be such a LCD device. This makes use of the light emitter in the wand by sensing the reflection or lack of reflection of the signals emitted thereby, and can result
20 in a reduction of battery drain and other advantages.

The principles of the invention also can be used to advantage in indicating and reading out from a tape reel or cassette other information regarding the tape such as the location in the tape at which information is being read.
25 This can be done, for example, by providing a radial array of sensors such as sensors 324 and 326 (Figure 18) and indicating which one is being covered by the tape roll. A single, elongated radial sensor in one flange and an opposed, elongated radial light emitter in the other flange
30 can be used as an analog tape roll position indicator. The analog output of the sensor is proportional to the portion of its surface area which is illuminated. In either case, the signals are encoded and read out as described above.

Other switches can be used instead of the pressure
35 switch 329. For example, in addition to the light-responsive switch mentioned above with respect to Figure 16, a switch which operates in response to a change

1 in capacitance caused by the bar-code reading wand coming
near the LED 334. Such other switches have no moving parts.
Thus it will be realized that the inventive means to
automatically count the number of times that pre-recorded
5 material has been played, or substantially played, may take
several forms, as:-

- (a) sensing tape "play" tension against time;
- (b) sensing spool rotation against time;
- (c) sensing number of spool rotations
- 10 electronically;
- d) sensing tape movement by capacitance against
time; that is to say, footage played;
- (e) sensing electromagnetic radiation of player
against time.

15 There again, change in diameter of a tape reel may
equally well be sensed optically, magnetically, by
capacitance, etc.

It is further contemplated that the present
invention will actively encourage all distributors to ensure
20 that all video copies of new films and all new copies of old
films are made on cassettes with built-in counters, as such
is very much in their own interests. There again,
purchasers of new cassettes, whether pre-recorded or blank,
may well regard a counter as a desirable "extra", enabling
25 them to keep track of tape and/or head wear.

Installation of the inventive counters will permit all
supplies of new and replacement cassettes to be based on
fee-per-use contracts, thus making the proposition highly
attractive to video shop operators by substantially reducing
30 their initial outlay and so allowing them to carry more
copies of successful films and a greater variety of films in
general.

It is envisaged that the first application of this
invention will be to the licensing for use and renting of
35 video cassettes, but that subsequent applications will
include all electronic, electromagnetic and light-spectrum
recording media.

1 Although this invention has been described above with
reference to video cassettes, the principles thereof are
equally applicable to audio cassettes and cartridges and the
like.

5 From the above-going, those skilled in the art will
readily appreciate that video cassettes incorporating
counting devices according to the present invention will
provide the public with a new or much-improved article or,
at the very least, offer to it a useful and attractive
10 choice.

 Although the invention has been described above with
reference to examples and to preferred embodiments, it will
be appreciated that the invention may be embodied in other
forms or carried out in other ways without departing from
15 the spirit or essential characteristics thereof. The above
description is therefore to be considered in all respects,
illustrative and not restrictive, and all changes which come
within the meaning and range of equivalency are intended to
be embraced therein.

1 CLAIMS

1. A video record rental method, said method comprising the steps of:

5

(a) providing a video record unit with means for counting the number of times the record is played;

10

(b) recording in a computer the identity and play count of each record unit as it is rented;

(c) recording in said computer the identity and play count of each such record unit as it is returned; and

15

(d) computing in said computer the amount of rental fees due based on the net play count for each record unit.

2. A video record rental system, said system comprising in combination, a plurality of computer rental terminals each located at a separate rental site, a central computer, a data transmission link between each of said rental terminals and said central computer, a plurality of computer terminals, each located on the premises of a video record source, data links connecting said central computer with each of the latter computer terminals, and means enabling the recording of rental transactions at the rental terminals, including the number of plays of each record rented, and for transmitting said rental data to said central computer, means for enabling said central computer to compile rental data from the rental terminals into a report and transmit the report to the appropriate one of said record sources.

30

3. A video tape cassette with integral means for counting and indicating the number of times the tape has been played, said cassette comprising, in combination, a housing;

35

1 a tape dispensing reel and a tape take-up
reel rotatably mounted in said housing, said reels being
relatively free to move about laterally in said housing when
said cassette is not engaged in a video tape playing
5 machine;

a counter; and
detecting means for detecting changes in the
size of one of the rolls of tape on one of said reels and
driving said counter to indicate one play in response to a
10 predetermined change, and for substantially neutralizing the
effect on said detecting means of lateral movement of said
reels in said housing.

4. A reel-to-reel magnetic tape cassette, said
cassette comprising:

15 (a) a case;

(b) a tape delivery reel mounted in said
case, said delivery reel having castellations on its
periphery;

(c) a tape take-up reel mounted in said
20 case, said take-up reel having castellations on its
periphery;

(d) brake means for preventing rotation of
said tape delivery reel and said tape take-up reel when said
cassette is not inserted in a player device, said means
25 comprising a pair of arms pivotally mounted on a common axis
onto said cassette case each of said arms having a free end,
means for resiliently urging said arms apart so that said
free end of each arm engages one of the castellations of a
respective tape reel to prevent rotation of said reel, and
30 means responsive to insertion of a brake deactivating pin
between said arms for urging said arms together to permit
rotation of said reels when said cassette is inserted into a
player device and said brake deactivating pin is inserted
into said cassette.

35 5. Apparatus for providing an electronic
read-out of information stored in a record housing, said
apparatus comprising, in combination, encoding means in said

1 housing for encoding said information into a coded form
consisting of electrical signals; optical means responsive
to said electrical signals for producing corresponding coded
optical signals, said housing having access means to permit
5 reflectivity in response to a series of timed signals so as
to simulate a bar code to a stationary bar-code scanner.

6. An information-indicating recording tape
reel, said reel comprising, in combination, a hub, at least
one tape-retaining flange extending from said hub, detecting
10 means for detecting information regarding the relative
position of said tape on said reel, electrical encoding
means mounted on said reel for encoding said information
into electrical signals, and optical means responsive to
said electrical signals for providing a coded optical output
15 of said information, said output being detectable from
outside said reel by optical code detection means.

7. A method of reading out a count indicating
the number of plays of a program recorded on recording tape
in a cassette, said method comprising the steps of
20 developing in said cassette a count signal representing the
number of such plays, encoding said count signal to produce
signals to drive an optical count-indicating device readable
with an optical code reading device, and reading said code
with an optical code-reading device.

116

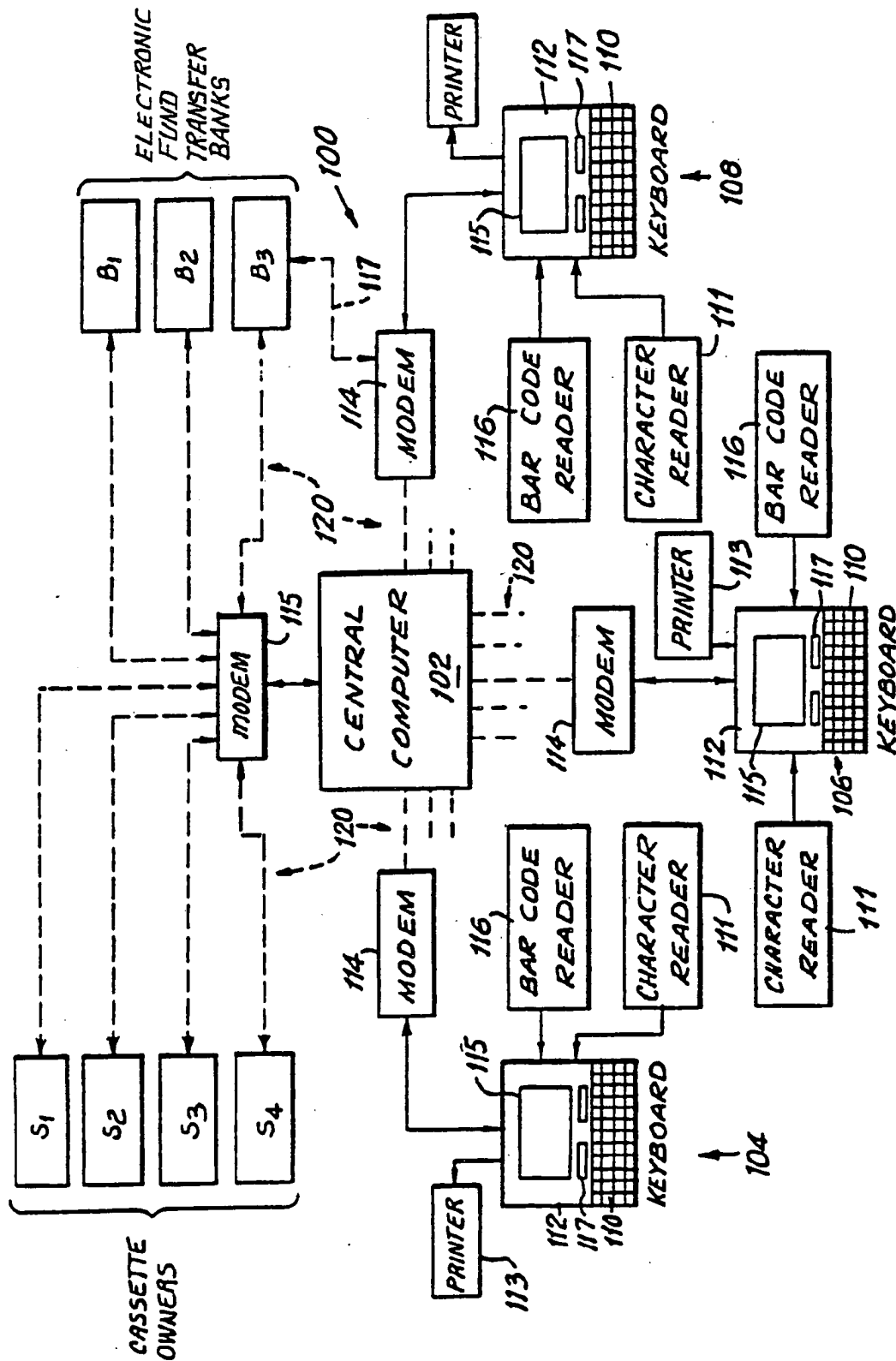


FIG. 1

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FIG. 8

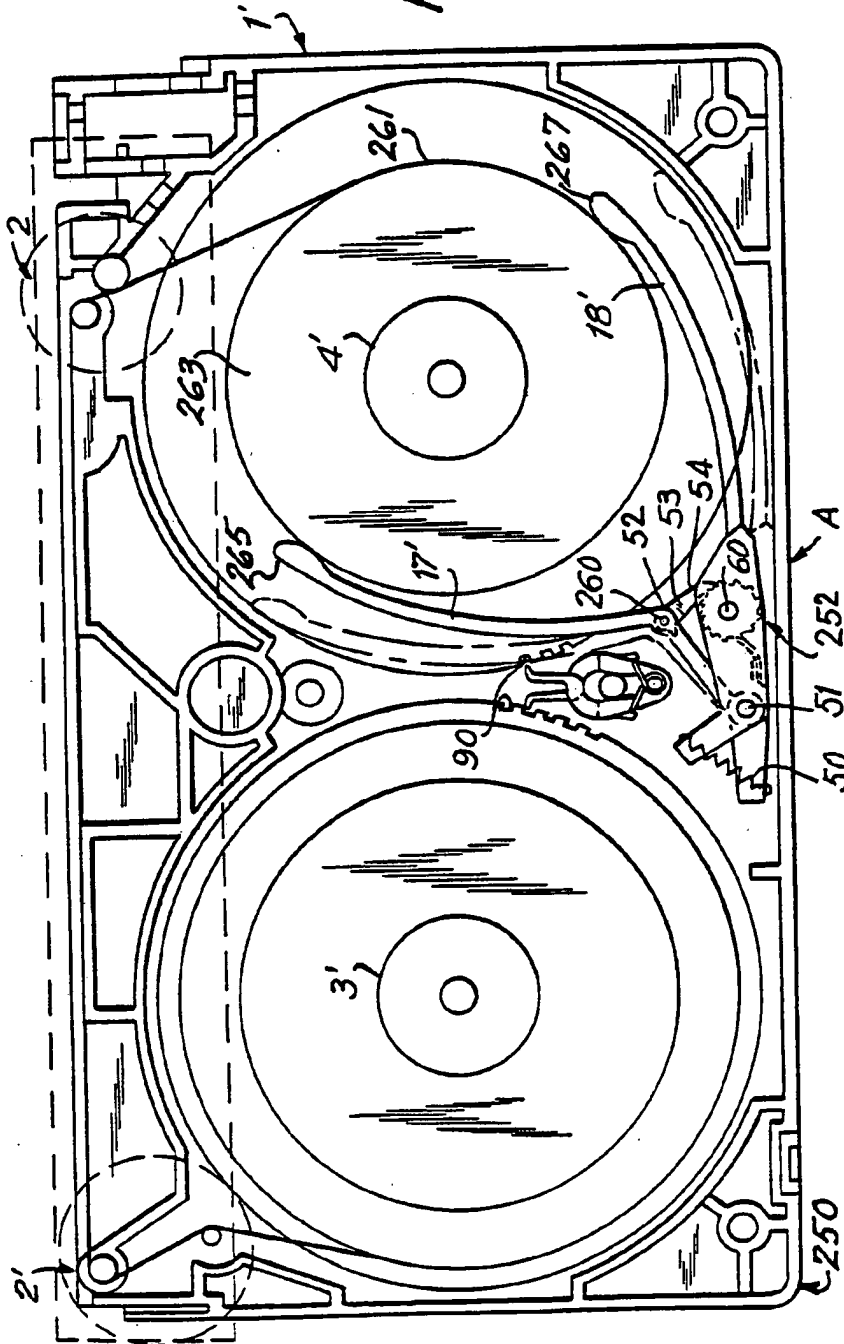
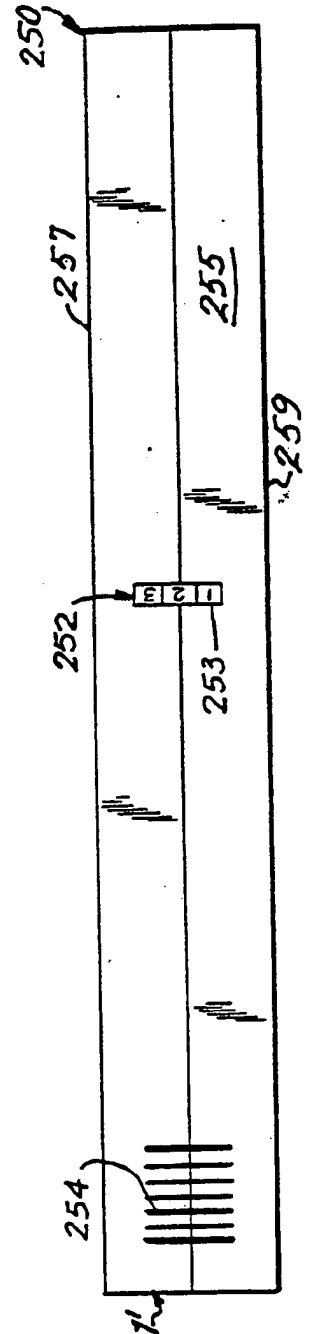
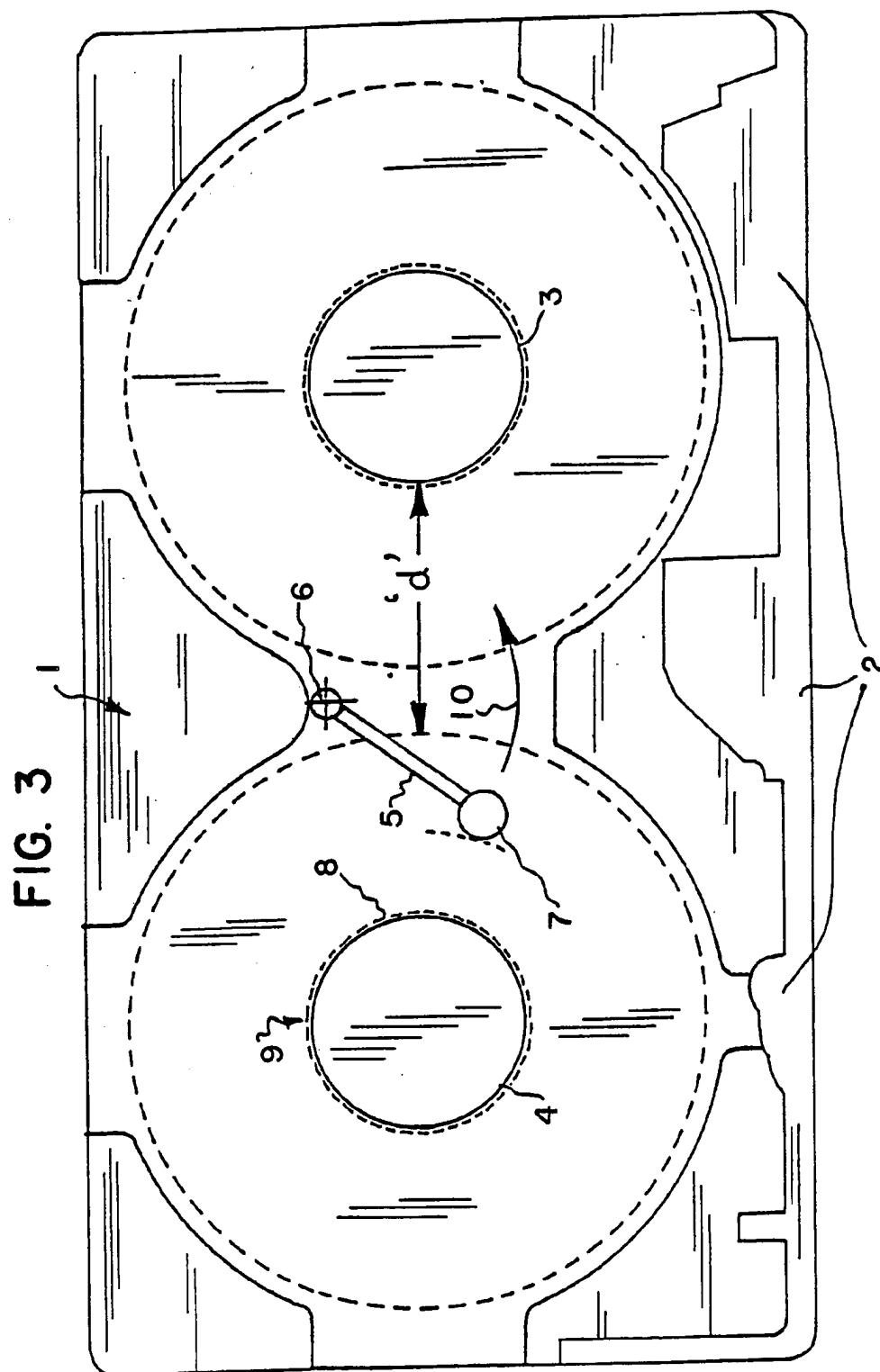


FIG. 2

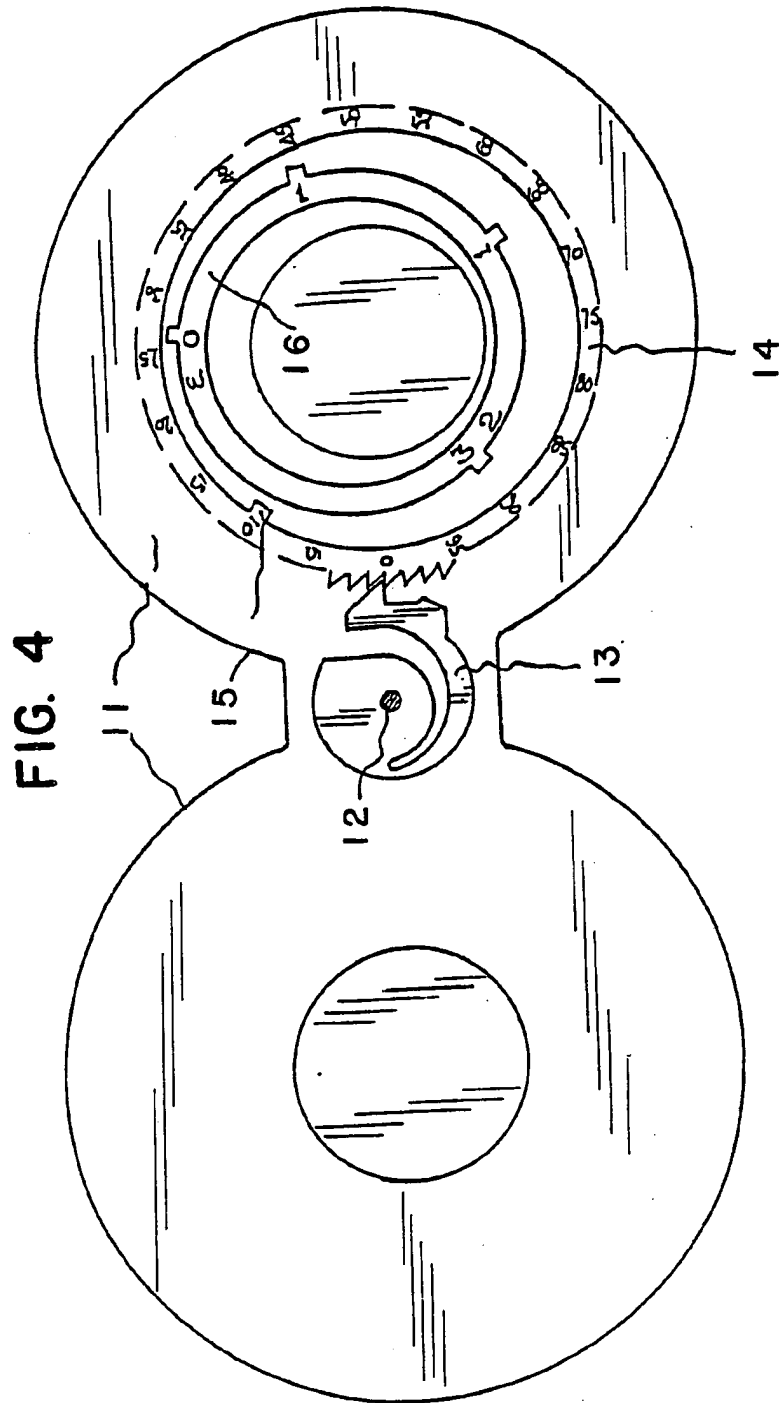


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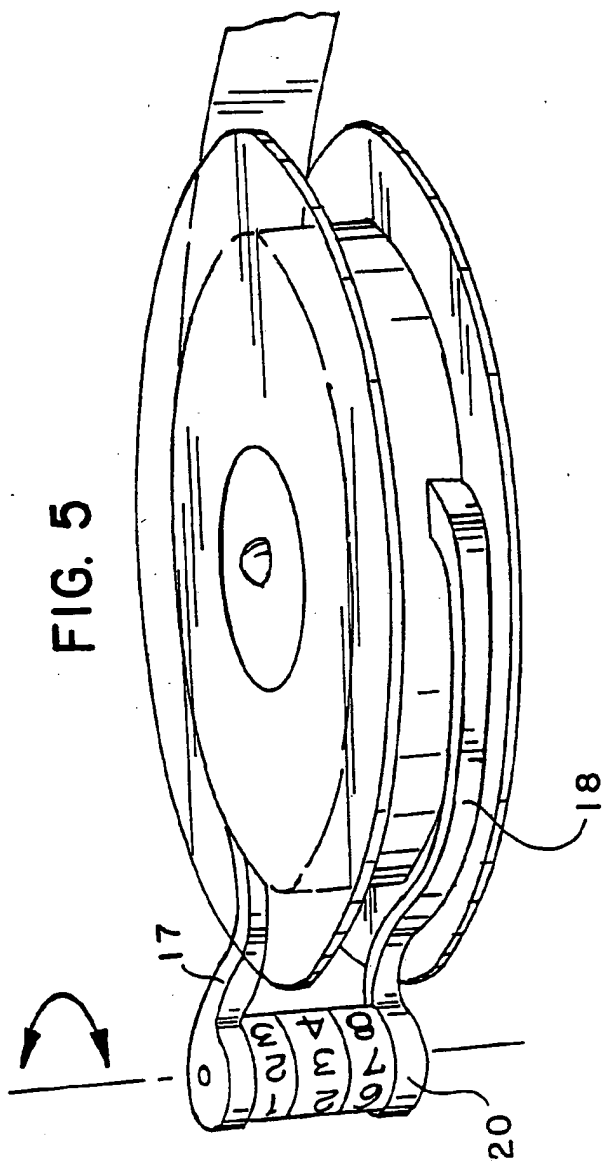


SUBSTITUTE SHEET

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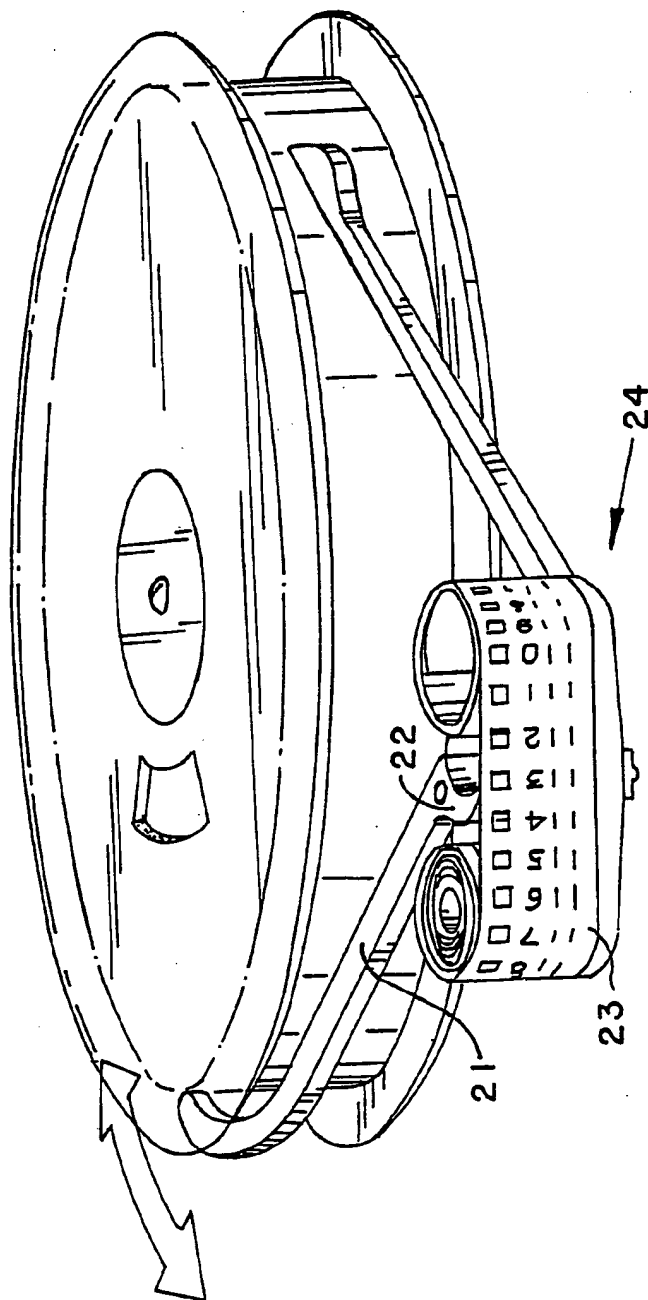
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SUBSTITUTE SHEET

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FIG. 6



SUBSTITUTE SHEET

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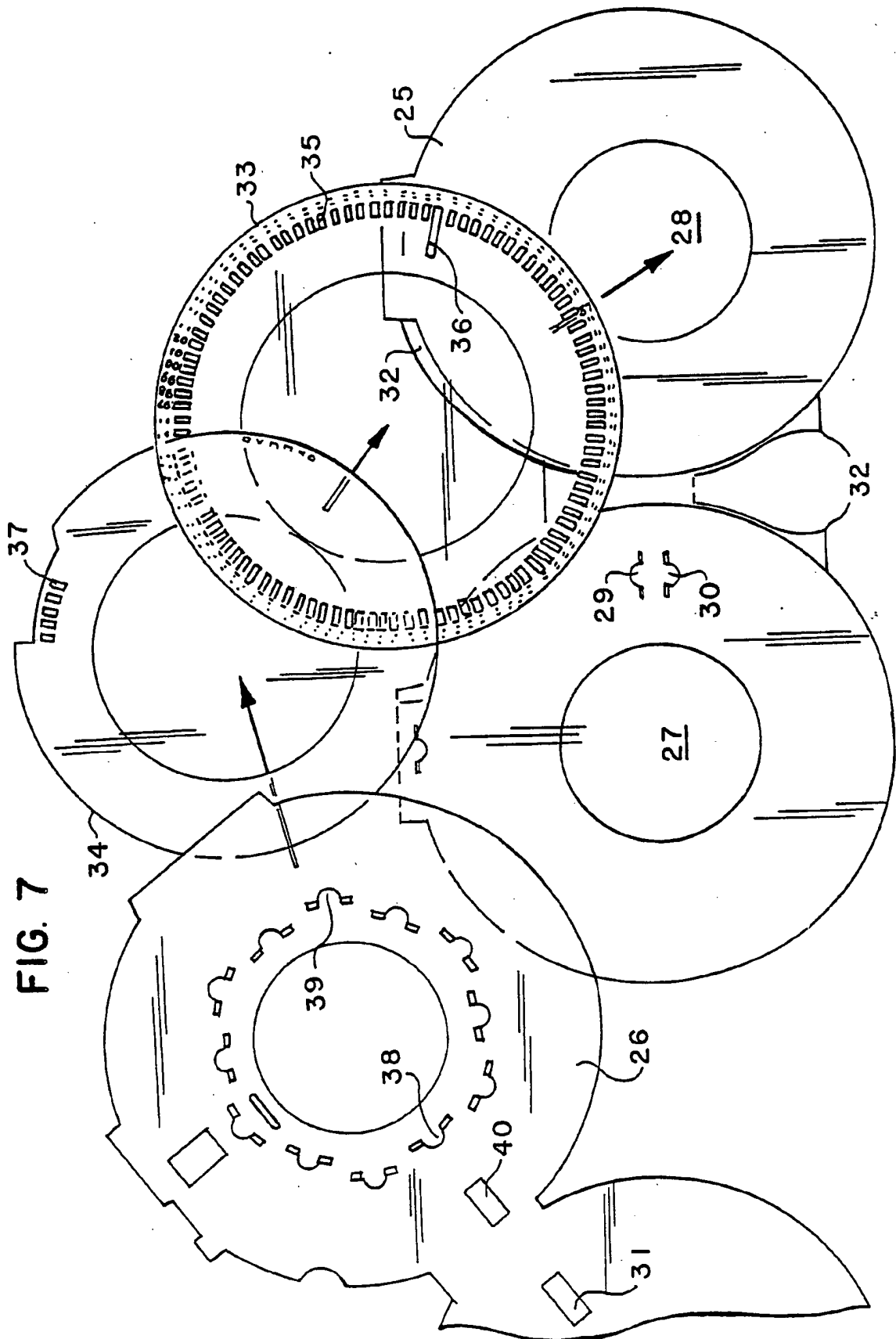
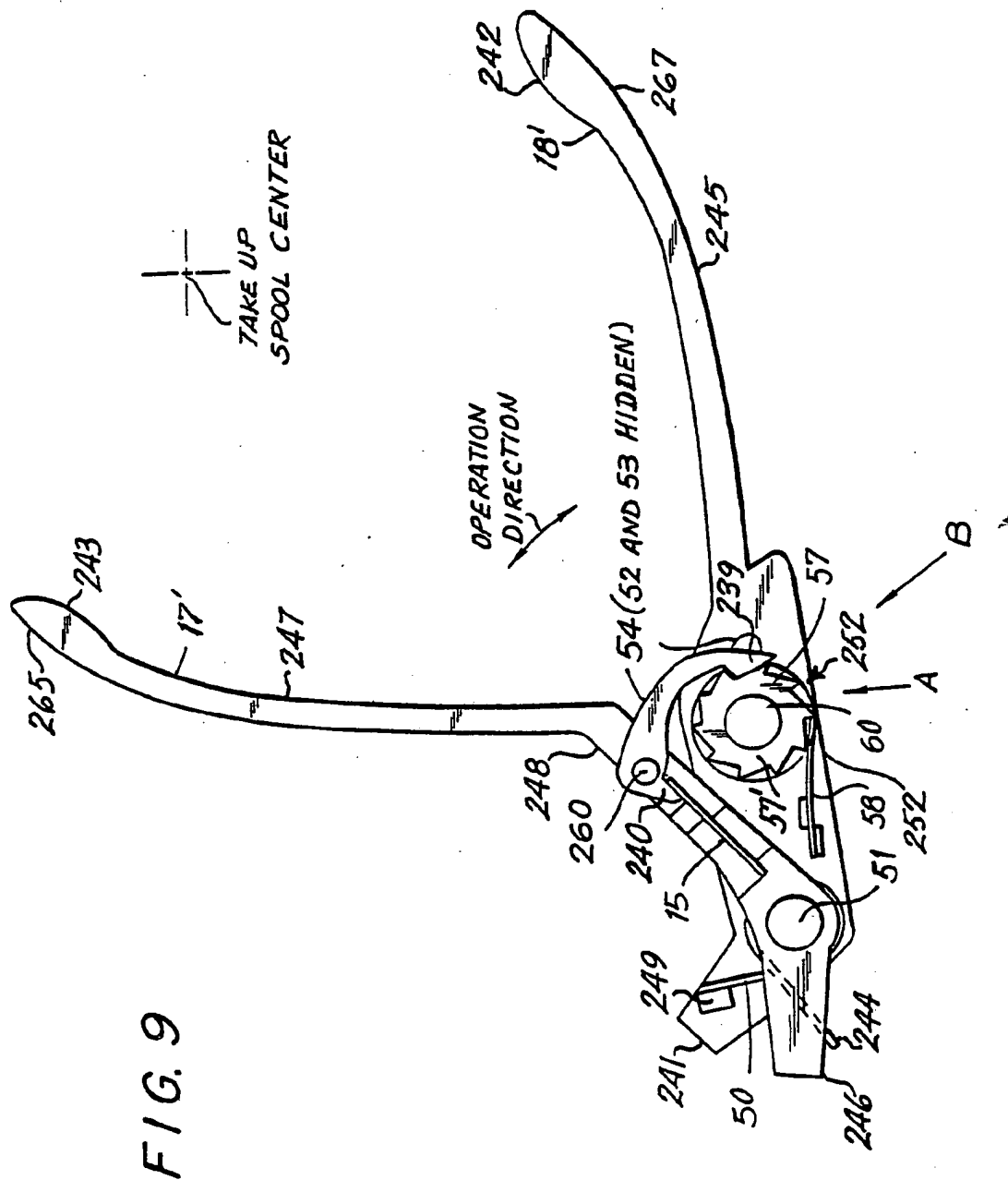


FIG. 7

SUBSTITUTE SHEET

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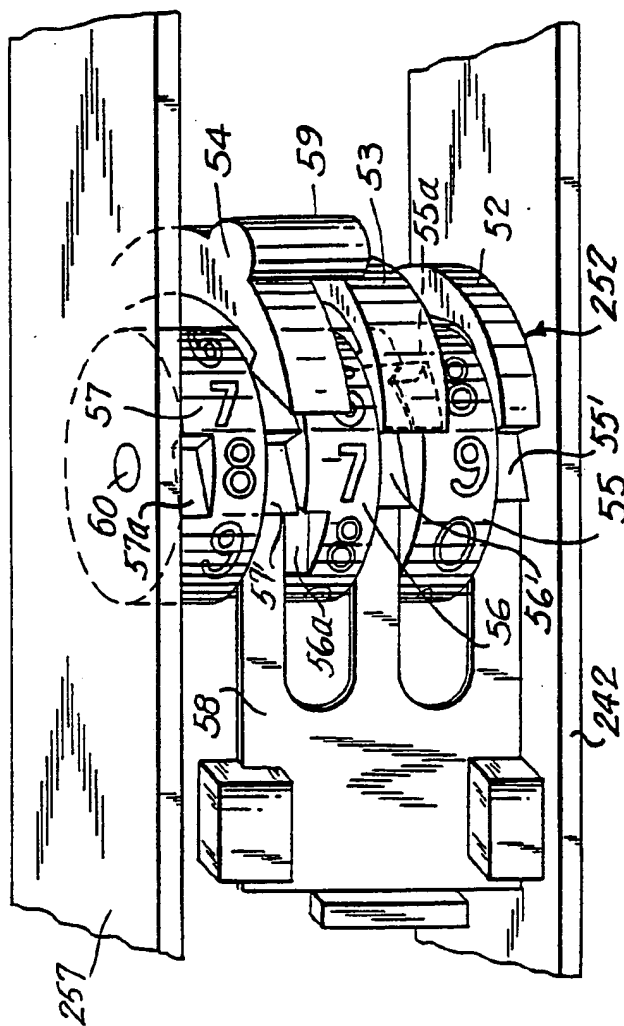


FIG. 10

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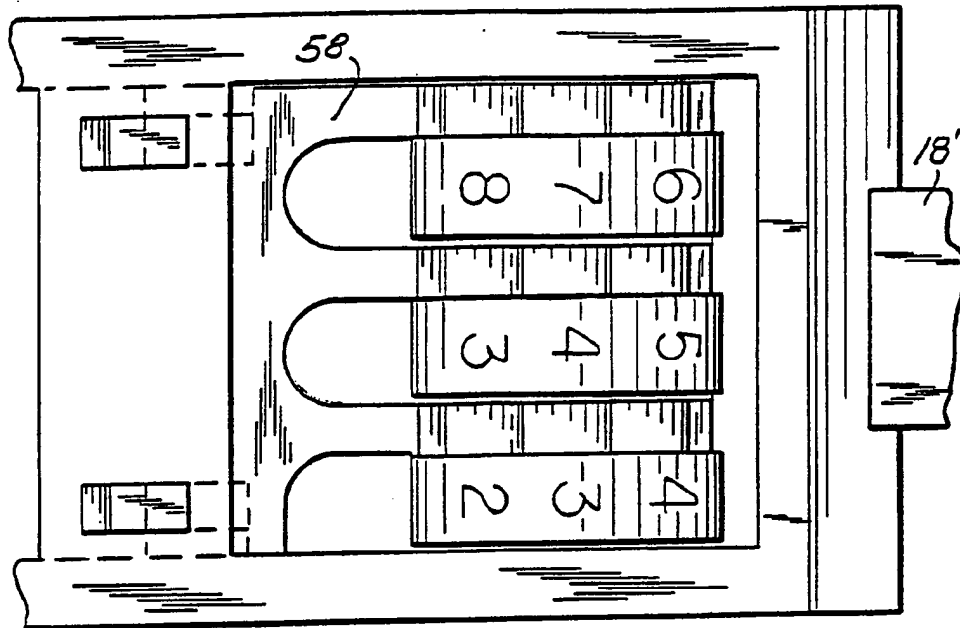


FIG. 11

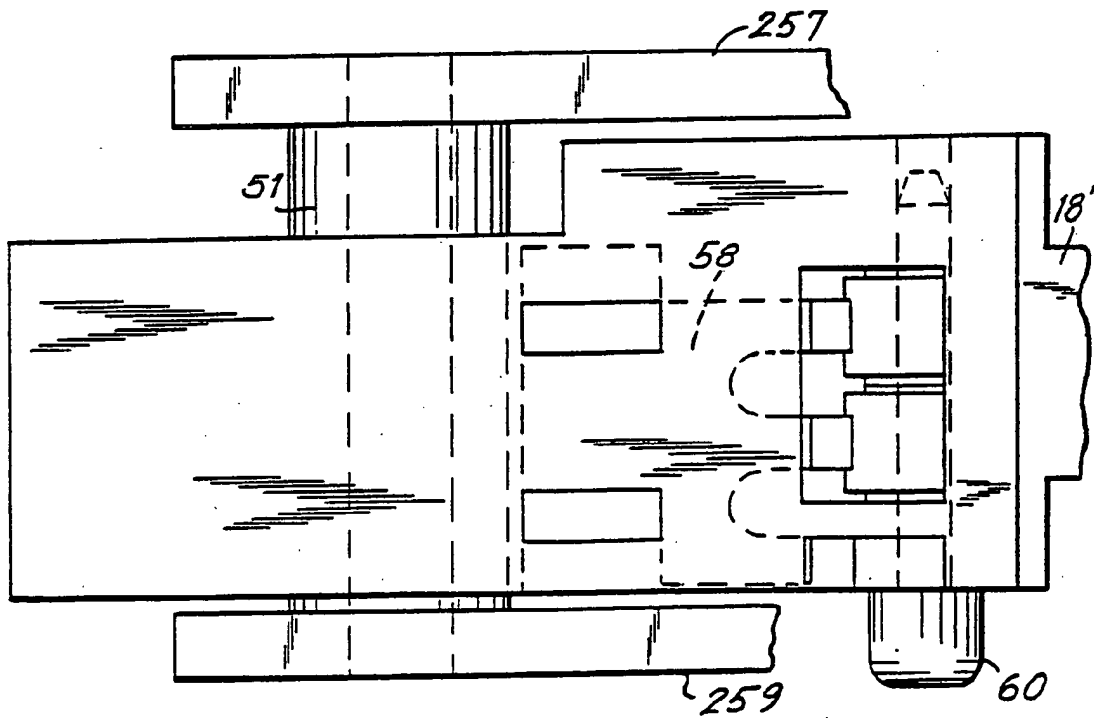
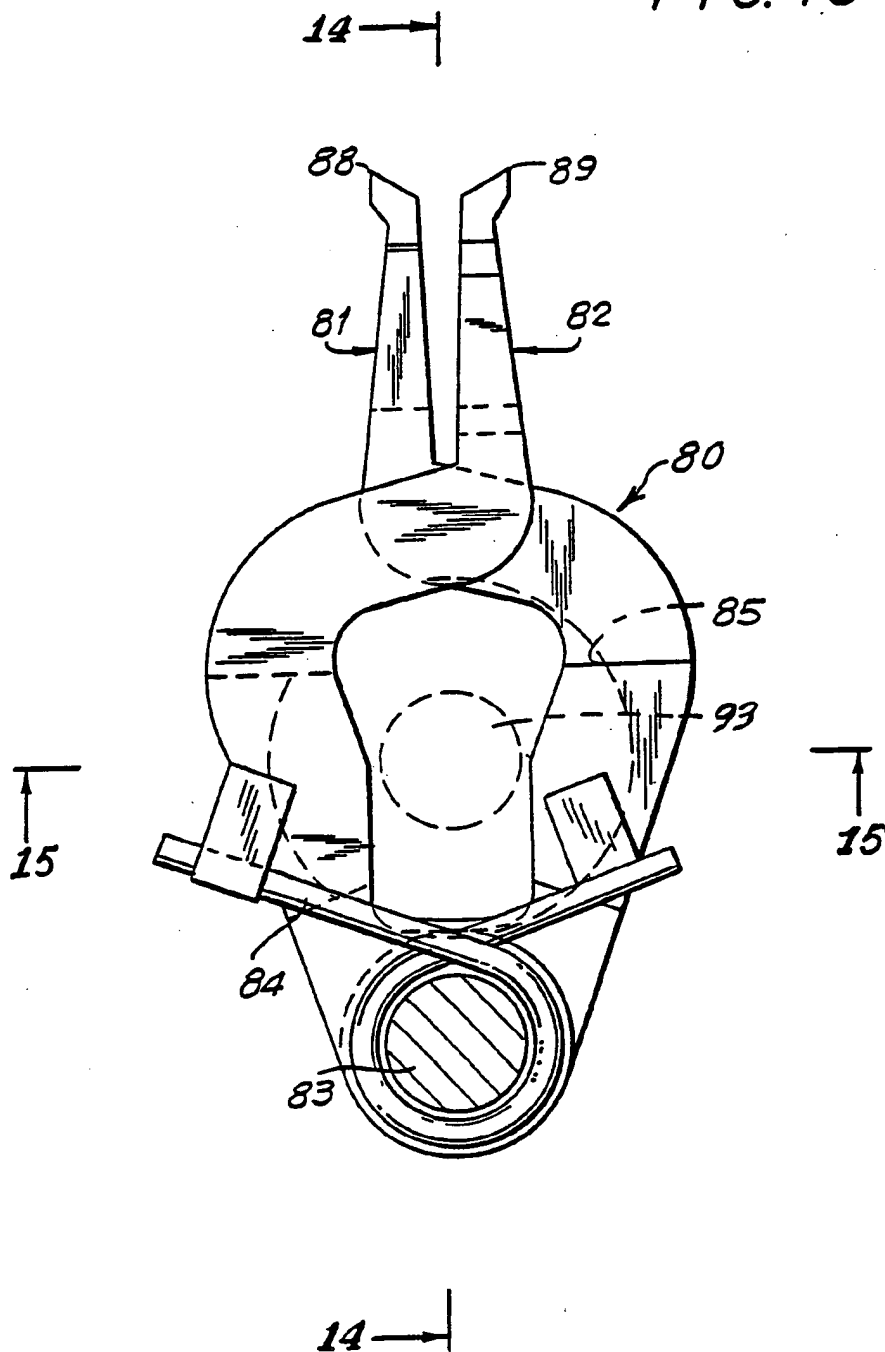


FIG. 12

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FIG. 13



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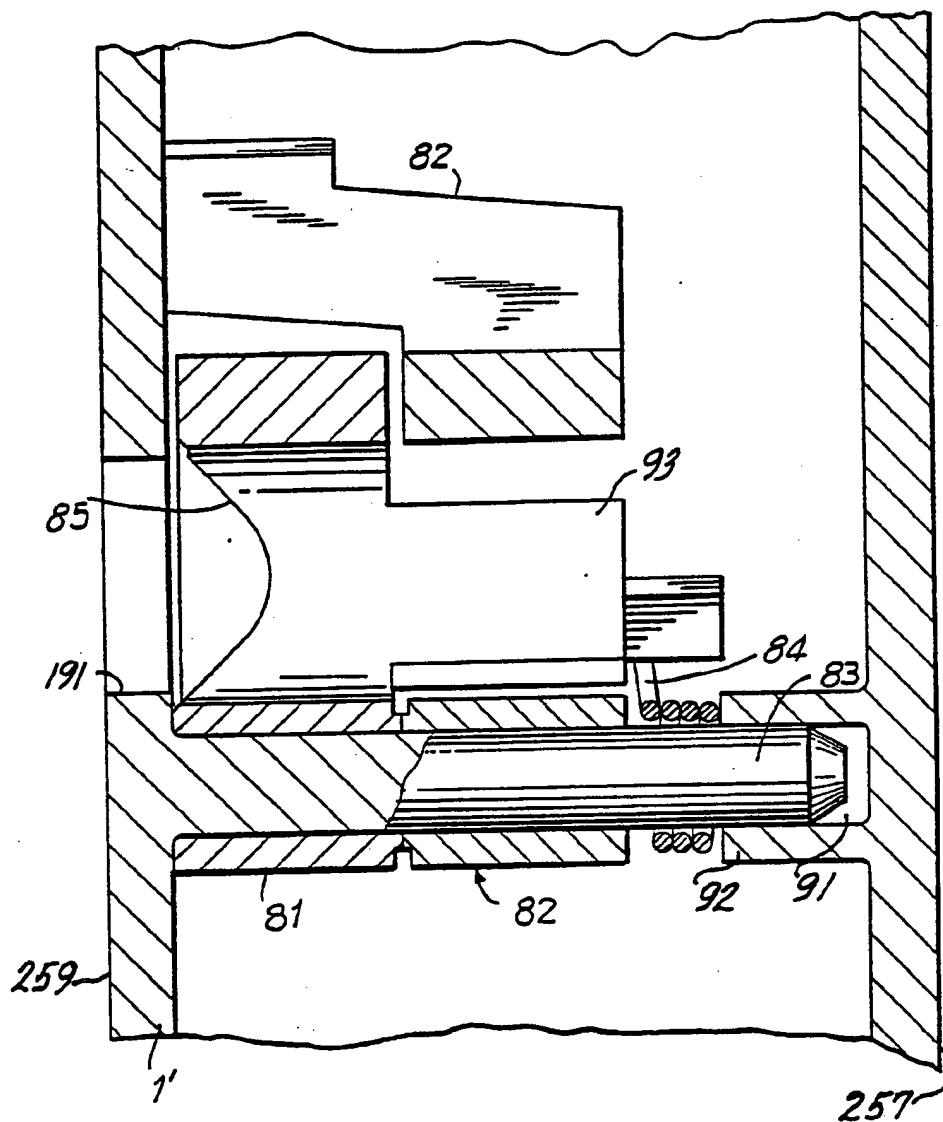


FIG. 14

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FIG. 15

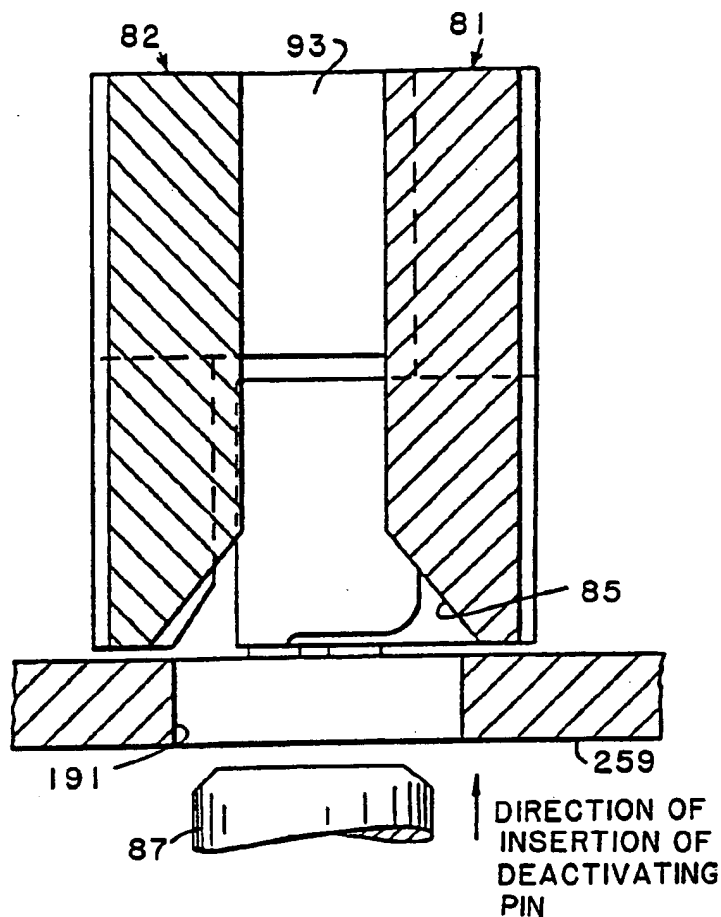
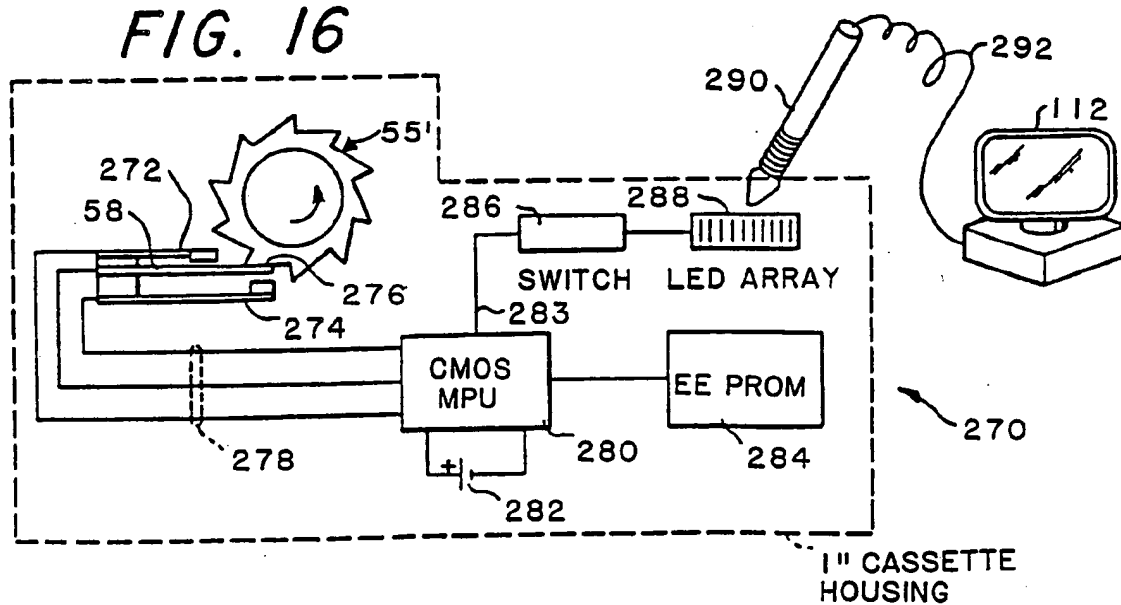


FIG. 16



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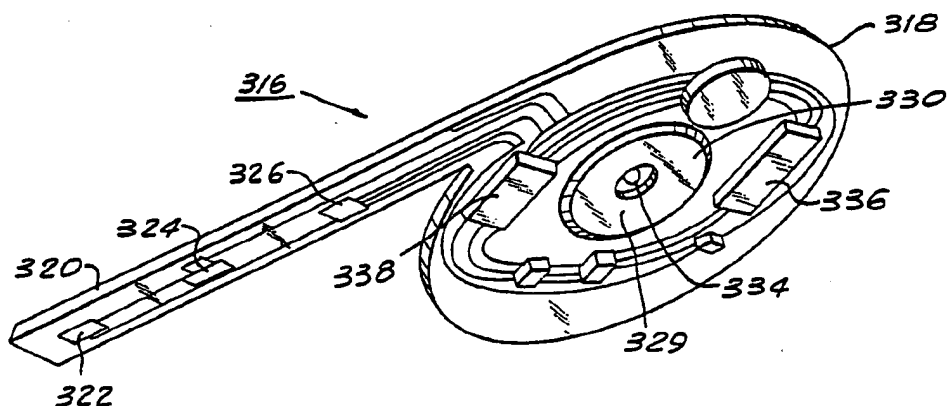


FIG. 18

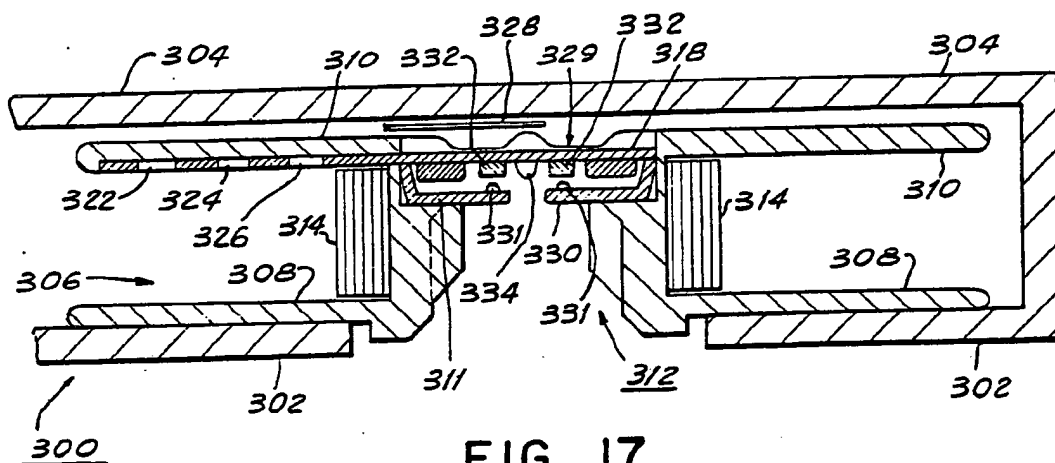


FIG. 17

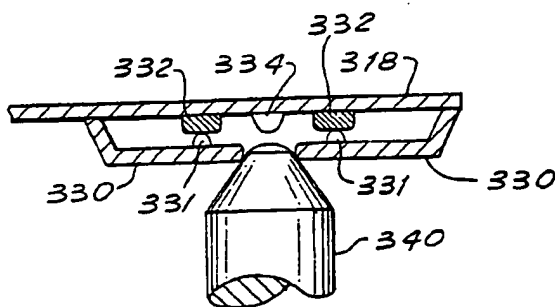


FIG. 19

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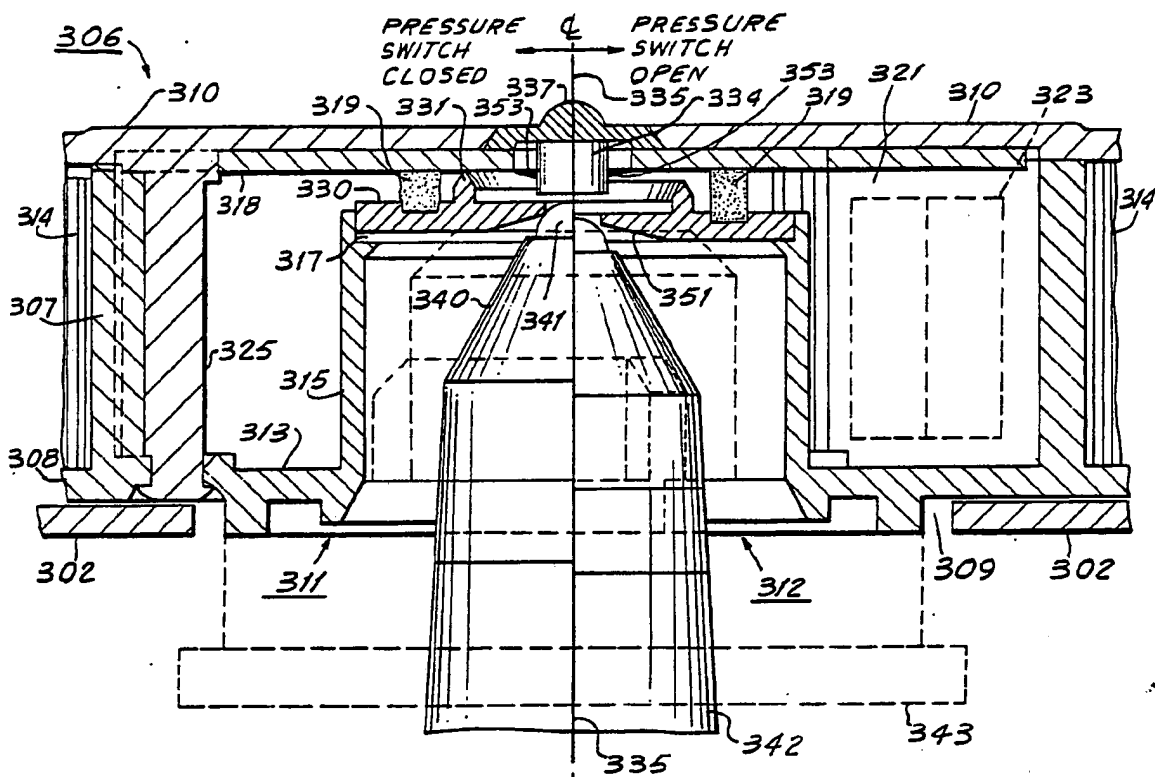


FIG. 20

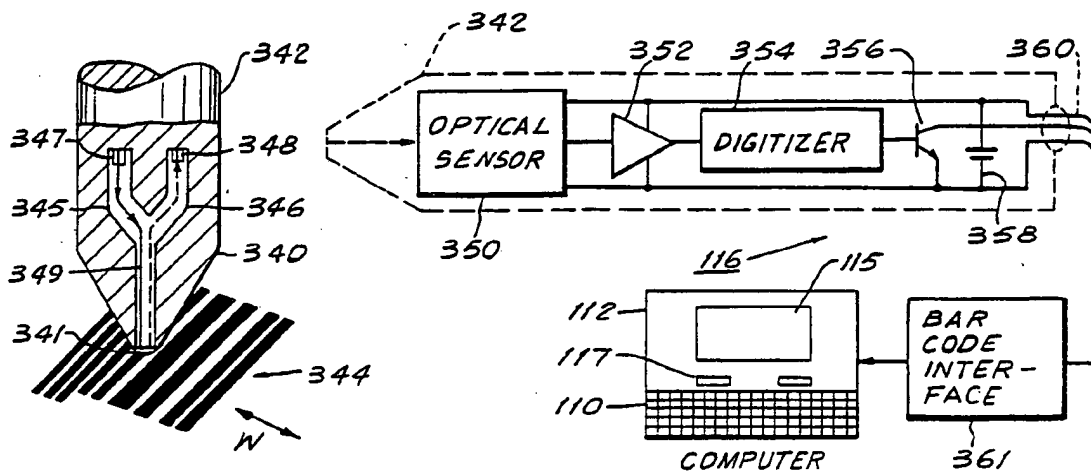
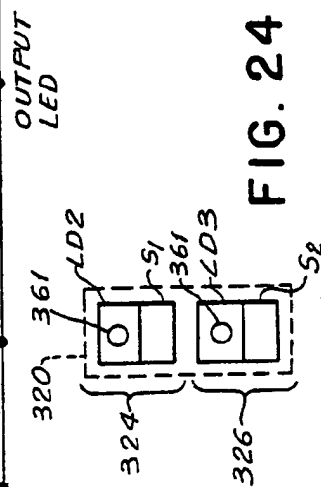
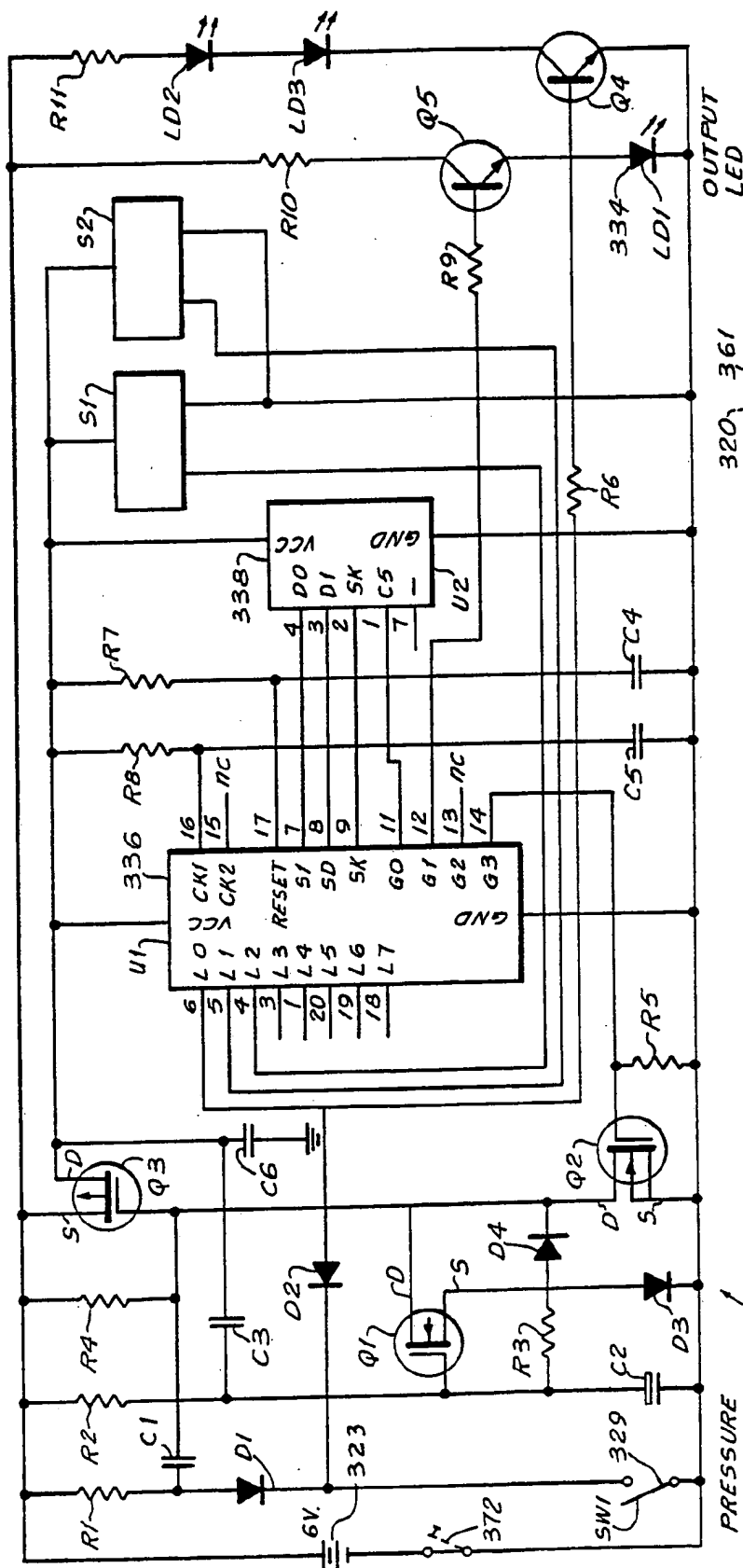


FIG. 22

FIG. 23

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INTERNATIONAL SEARCH REPORT

International Application No. PCT/US88/03942

I. CLASSIFICATION OF SUBJECT MATTER (If several classifications apply, indicate all)⁶
 According to International Patent Classification (IPC) or to both National Classification and IPC
 IPC(4): G11B 23/02, 15/32, 23/04; G03B 1/04; G06F 15/02, 15/24
 U.S. Cl.: 360/132, 137; 242/199; 364/401, 478

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System	Classification Symbols
U.S. Cl.	186/35, 52, 59; 221/88, 195; 235/454, 462, 472; 242/197-201; 360/90, 92, 132, 137; 364/131, 188-189, 401, 424.04, 478, 479; 414/273

Documentation Searched other than Minimum Documentation
 to the Extent that such Documents are Included in the Fields Searched⁸

III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	JP, A, 60-214,486 (YOSHII) 26 October 1985 (See Figures 2-8)	4
$\frac{X}{Y}$	US, A, 3,995,319 (HARRIS) 30 November 1976 (See entire document)	3 1-2
$\frac{X}{Y}$	US, A, 4,586,101 (VOGELGESANG) 11 March 1986 (See entire document)	3 1-2
$\frac{X}{Y}$	US, A, 4,466,584 (CHEVALIER ET AL.) 21 August 1984 (See entire document)	3 1-2
$\frac{X}{Y}$	US, A, 4,554,443 (LAMBERT ET AL.) 19 November 1985 (See Abstract and column 2 lines 48-68)	7 1-2
$\frac{X}{Y}$, P	US, A, 4,593,337 (LEONE ET AL.) 3 June 1988 (See entire document)	6-7 1-2, 5
$\frac{X}{Y}$	JP, A, 58-189883 (TANAKA) 5 November 1983 (See constitution)	6-7 1-2, 5
	(Continued)	

- ^{*} Special categories of cited documents: ¹⁰
- "A" document defining the general state of the art which is not considered to be of particular relevance
 - "E" earlier document but published on or after the international filing date
 - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 - "O" document referring to an oral disclosure, use, exhibition or other means
 - "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

Date of Mailing of this International Search Report

2 FEBRUARY 1989

19 APR 1989

International Searching Authority

Signature of Authorized Officer

ISA/US

David J. Severin
DAVID J. SEVERIN

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y, P	US, A, 4,736,096 (USHIKUBO) 5 April 1988 (See entire document)	5
A	US, A, 4,475,222 (EGENDORF) 2 October 1984 (See entire document)	1-3
A	US, A, 4,575,778 (VOGELGESANG) 11 March 1986 (See entire document)	1-3
A	WO, A, 8,401,657 (WILLQUIST) 26 April 1984 (See entire document)	1-3
A	US, A, 4,072,850 (McGLYNN) 7 February 1978 (See entire document)	1-2
A	US, A, 4,598,810 (SHORE ET AL.) 8 July 1986 (See entire document)	1-3
A, P	US, A, 4,710,616 (UTLEY) 1 December 1987 (See entire document)	2
A	US, A, 4,513,928 (HACKETT) 30 April 1985 (See entire document)	4
A	US, A, 4,660,116 (WESTFALL ET AL.) 21 April 1987 (See entire document)	4
A	US, A, 4,338,644 (STARR) 6 July 1982 (See entire document)	5-7
A	FR, A, 2,461,229 (SECHET) 6 March 1982 (See entire document)	5-7
A, P	US, A, 4,712,149 (GOTO ET AL.) 8 December 1987 (See entire document)	4
A, P	US, A, 4,723,181 (HICKOK) 2 February 1988 (See entire document)	5-7
A	JP, A, 58-41472 (YAMASHITA) 10 March 1983 (See constitution)	5-7

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers _____, because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers _____, because they relate to parts of the International application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

3. ☐ Claim numbers _____, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹

This International Searching Authority found multiple inventions in this international application as follows:

Group I, claim 1, drawn to video record rental method.
 Group II, claim 2, drawn to video record rental system.
 Group III, claim 3, drawn to tape cassette with a play count.
 (Continued)

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application. Telephone practice.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

Attachment to Form PCT/ISA/210, Part VI 1.

Telephone approval:

\$700 payment approved by Gregor Neff on 21 December 1988 for Groups II-VI; charge to Deposit Account No. 03-3925. Counsel advised that he has no right to protest for any group not paid for and that any protest must be filed no later than 15 days from the date of mailing of the search report (Form 210).

Reasons for holding lack of unity of invention:

Groups I and II, classified in U.S. Class 364, Subclass 188 and U.S. Class 364, Subclass 401, respectively, set forth an overall system which does not require the specific cassettes or optical code readers of the other groups in order to function. Group I differs from Group II in that Group I uses a computer only to calculate the amounts of rental fees based on the number of times a video cassette has been played which could be practiced by hand while Group II sets forth multiple terminals with data links to a central processor and compilation of rental data based on information relayed between these elements.

Attachment to Form PCT/ISA/210, Part VI 1.

Group III classified in U.S. Class 360, Subclass 132 sets forth a video cassette to count the number of plays based on the change in size of one of two rolls of tape. This group functions independently of specific brake means (Group IV) or optical reading (Groups V-VI).

Group IV classified in Class 242, Subclass 199, sets forth a video cassette with a reel brake member which functions independently of the optical reading devices of Groups V-VI.

Group V, classified in U.S. Class 360, Subclass 93, differs from Group VI, classified in U.S. Class 242, Subclass 55.17, in that Group V sets forth only a reel with an optical output coder which acts independently of a cassette (or record housing) required by Group V.

Time Limit for Filing a Protest

Applicant is hereby given 15 days from the mailing date of this Search Report in which to file a protest of the holding of lack of unity of invention. In accordance with PCT Rule 40.2 applicant may protest the holding lack of unit only with respect to the group(s) paid for.

VI. OBSERVATIONS WHERE UNITY OF THE INVENTION IS LACKING

Group IV, claim 4, drawn to reel-to-reel cassette with a reel brake.

Group V, claims 5 and 7, drawn to method and apparatus to read optical information on encoding means in a tape cassette.

Group VI, claim 6, drawn to tape reel with an optical output.